EDITORIAL

THE stereo broadcasts in Sydney and Melbourne which took place during the month were most significant in the history of Australian broadcasting, particularly in the light of overseas developments.

They also reflect much credit on the enterprise of the stations which staged them.

In Sydney, 2CH and 2SM were first in the field on the evening of August 6, followed by 3UZ and 3XY in Melbourne two days later.

At the time of writing, the Sydney stations at least propose to continue, and are hopeful of obtaining sponsorship which will allow them to plan a series for the next 12 months, with extended listening time.

In America, stereo broadcasts are regularly carried out by operators of AM-FM stations, using one station for each channel. Due to fundamental differences in transmitting standards, there are objections to this method which do not apply in our case, and we have the added advantage that, with good promotion, a sponsor can look forward to reaching the combined audiences of two stations.

The initial broadcasts were sufficiently successful to show beyond doubt that something excitingly new has come to broadcasting. Not the least encouraging aspect has been the reports from many listeners that, despite the enforced use of one large and one small set, substantial stereo was achieved.

If the transmissions are sufficiently numerous and well produced, there is no doubt that many people will consider some permanent or easily achieved set-up which will reduce greatly the nuisance value of arranging for the two sets in their living rooms.

The programs themselves have the potential to become star listening spots in the week's broadcasting, particularly as more and better material will soon be with us. Program executives have already learned many lessons in presentation from their first efforts.

Without doubt the ideal stereo method is to use multiplexed FM stations, accommodating both channels on the one transmission, a system which allows complete compatibility for those who use receivers with only one channel facilities.

The future here looks so attractive that I regret still further the failure of the present broadcast operators to support the move for FM stations in Australia. I think they have failed to look far enough ahead in laying their plans for the future.

The results of the recent FM inquiry are not yet to hand, but the advent of stereo may present us with possibilities so far completely overlooked. From now on it can be a terrific seller.

John Moyle

INDEX

	Page
First Views of Atlas Engines	3
I was Weightless for 39 secs.	4
What We Know about the Moon	9
New Approach to Baby Player ..	13
Belt Radio Helps Fight Crime ..	15
Gold Is Where You Find It	16
Technical Review	21
News and Views of the Month	29
R/C Bridge (1958)	32
From the Serviceman Who Tells ..	41
Here's Your Answer, Tom!	46
A Simple Speaker Baffle	48
New Layout for 17W Playmaster ..	51
More About Transistor Sets	55
1958 TV Set With 5BP1 Tube	64
Making A Mantel Set Cabinet ..	73
A Reader Built It!	79
A Course In Television—Part 30 ..	80
Getting Your Amateur Licence ..	87
Let's Buy An Argument	96
Off The Record—News and Reviews	102
Short-Wave Notes	112
The Ham Bands	113
Answers to Correspondents	125

RADIO TELEVISION AND HOBBIES

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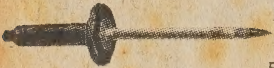

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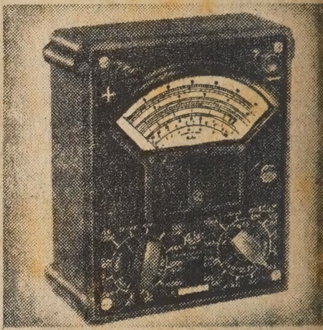

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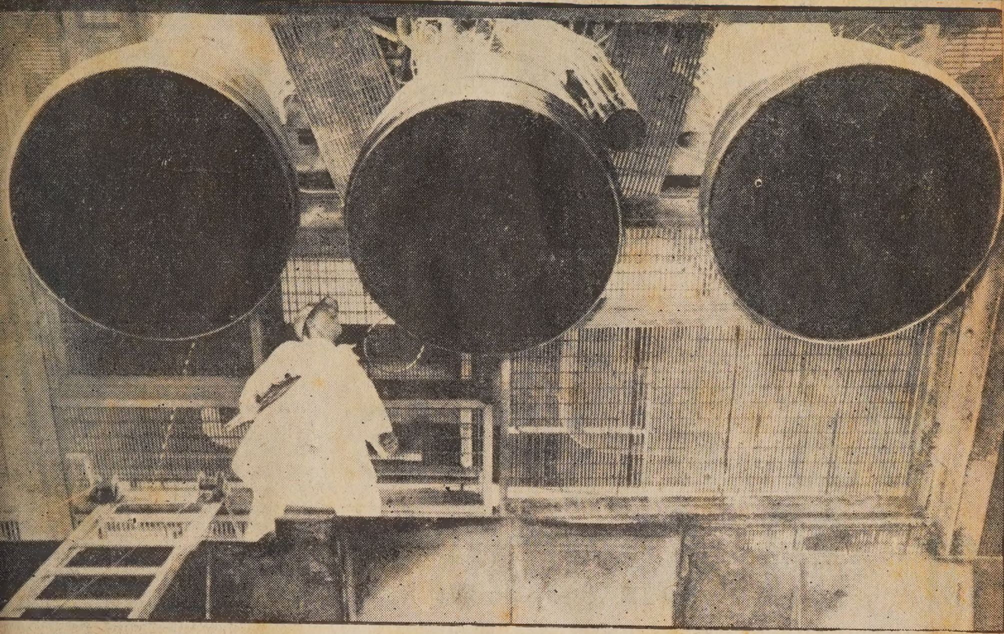
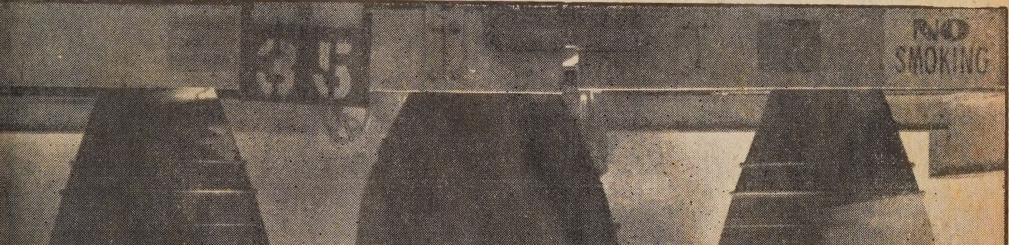
FIRST VIEWS OF ATLAS ENGINES



THIS IS THE FIRST PHOTOGRAPH of America's most powerful cluster of rocket engines, released by permission of the U.S. Air Force following initiation of long-range flight tests of Atlas ICBM's at Cape Canaveral. The primary units are composed of a twin-chambered booster at left and right and a sustainer in the centre. The propulsion system also includes two small vernier or stabilizing engines mounted on the missile frame to prevent roll.



Slight distortion in centre chamber, which is the sustainer engine of the U.S.A.F. Atlas intercontinental ballistic missile propulsion system, is caused by gimballing of the engine during full-power test. Twin chambers on either side make up the booster engine, which lifts the massive ICBM from the ground and through the heavy atmosphere. (See story page 7) ght—Picture of the writer, pale but resolute, own with Major Herbert Stollings, pilot of the rcraft in which the "weightless" flight was made.

I Was Weightless For 39 Seconds

One of the unknown factors about space travel concerns man's physical reaction to weightlessness as would be experienced in outer space. It is quite probable that many physical and psychological functions are directly related to the presence of gravity. In this racy article, the writer describes his reactions to a flight in which true weightlessness was simulated for a short period.

By *Eliot Tozer*

YOU'RE in for a thrill if you ever take a ride in a spaceship. You'll feel as though you've just reached the top of a roller coaster — and you'll hang there for the rest of the trip through space. It will be like a pleasant dream without sleep. You'll barely hear the monotonous click and hum of the spaceship's electronic gear. You may wish you never had to come back.

Or you may be as sick as a dog. You may feel hot, feverish, then shudder with cold, struggle to draw each breath.

How come?

You'll be weightless. When your spaceship rockets up to orbital velocity, cancelling out the earth's gravitational field, the normal reassuring pull of gravity will give way. The sensors in your inner ear, your skin, muscles, and connective tissue will go limp and you'll enter a strange and dream-like state of mild exhilaration — or get sick.

All this the doctors told me at the School of Aviation Medicine, Randolph Air Force Base, Texas, where they are studying the effects of zero gravity on human behaviour and physiology. Knowledge gained from these experiments will be of immense value in designing the manned earth satellites and space vehicles of the future.

I had been sent down to Randolph to join the little group of men — there are not very many — who have been truly weightless and record my sensations while in that strange condition.

Now the medics were giving me a thorough physical examination. Later, after a pressure-chamber "flight" to 25-000 feet, I would strap myself into the back seat of an F-94 Starfire and climb about five miles above south Texas. There, with Major Herbert Stallings at the controls, I would ride the parabolic arc that produces the longest periods of zero gravity attainable — so far. As an ex-Navy pilot, I had done a good bit of flying, but now I was on the threshold of a totally new experience.

FINAL BRIEFING

I got my final briefing from Dr Siegfried Gerathewohl, probably the world's foremost expert on weightlessness. He said, "Major Stallings will dive to pick up speed. At about 450 knots, he'll pull up into a 70-degree climb. Then, with the afterburner on, he'll ease forward on the stick. As he continues to move the stick slowly forward, you'll gradually change direction from almost straight up, to level flight, to almost straight down. As you do, the centrifugal force will throw you up and away from your seat."

"But isn't that negative Gs?" I asked, "as in an outside loop?"

"No, because Herb will fly the airplane so that the centrifugal force always just counteracts the pull of gravity. With gravity cancelled out, you'll be weightless from the time you start your climb until you pull out at the end of the arc."

"How does Herb know we're exactly at zero gravity?"

"In our first experiments, we used a standard aircraft G meter," said Dr Gerathewohl. "It wasn't accurate enough. So we hung a golf ball on a string." He grinned. "When it floats, you're weightless."

Herb helped me adjust the straps on my crash helment. "You won't be weightless long," he said. "The record in an F-94 is 43 seconds. We can't get up enough speed to hang there longer than that."

We climbed into the jeep and headed slowly for the flight line. On the ground, this jet-jockey was an impressively cautious driver.

FLOATING BODIES

"What about the other experiments I've read about?" I said. "I've seen pictures of people floating around in the back end of a DC-3 and floating in water."

Dr Gerathewohl looked pained. "Anyone knows," he said, "that a DC-3 can't get up enough speed to fly a parabolic arc for more than two or three seconds. As for the water-tank tests, these are valuable — up to a point."

We parked beside the hangar and Herb went off to file our flight plan. Dr. Gerathewohl said, "You see, your body ha different kinds of gravity sensors. Mos important are the otoliths in your inne ear. Basically, they measure the pull o gravity."

I jotted down "otolith — pull o gravity."

"You also have thousands of pressure sensors, nerve endings in your skin muscles, and connective tissue. Now when you float in water, the area o pressure on these sensors is so large—as compared with the supporting are when you sit down, for example—tha

"My feet were off the floor – I was floating"

you may not feel the water pressure at all. It is like being weightless as far as your pressure sensors are concerned, but your otoliths still feel the pull of gravity."

"So if you want to be truly weightless, inside the earth's tmosphere, you have to fly a parabolic arc in a high-speed irplane?" I said.

"Either fly an arc or ride in an earth satellite," he said.

It was nearly 4 p.m. The left landing gear of the F-94 was dripping hydraulic fluid and Herb was down on his back wrestl-ng with a wrench as I climbed the ladder to the back cockpit. Basil McLeod, crew chief, helped strap me down, plugged in my radio jack, and turned on the oxygen. As he disappeared down the ladder, he said, "Major Stallings will show you how o bail out . . . just in case."

That's good of him, I thought. While Herb and McLeod plugged the hydraulic leak, I looked for a "burp bag" — and ound one neatly stashed between two black boxes. I noticed hat most of the instruments had been taken out of the back ockpit. There was no control stick, either. No chance to be hero and land this thing if something happens to Herb, I said o myself.

Herb poked his head in under the canopy to give me final nstructions. It turned out that blowing myself out of the F-94 would be comparatively simple: knees together, feet in the stir-ups, jettison the canopy, left armrest up, right armrest up, queeze trigger, pray.

WE START

At 4.16, Herb took a "thumbs up" from McLeod and hit the tarter button. I heard a dull whine behind me and almost im-mediately we were taxi-ing out. The mike in my oxygen mask picked up my breathing and sent it roaring into my earphones.

The F-94 is a solid, stub-winged interceptor that corners ike a Jaguar, and Herb taxied her like one. I took a notch in my harness.

"Randolph Ground Control," he said. "Six Five Zero for local flight. Over."

"Five Zero, cleared to runway three-two. Wind, six knots. Altimeter, 30.22."

"Roger," Herb said calmly. Then to me: "Okay, clear the anopy."

Instinctively, I pulled in my shoulders, and the canopy napped down.

"Switch to 100-percent oxygen."

I fumbled for the switch.

"Ready, chase?" he called.

Captain Warren Simpson pulled up beside us in a T-33. He would lumber along behind and below us to help us stay lear of traffic while we flew our parabolas. I heard him mutter, "Roger."

Herb got on the horn for final clearance and wheeled he F-94 into position for takeoff.

Something belted me in the backside. From the thunder hat shook the F-94, I gathered that Herb had cut in the after-burner. Within 25 seconds, we were off and climbing. I tarted to look around at the view, but it was gone. "How fast re we climbing?" I said.

"About 6,000ft per minute."

At that rate, the flight would be over before my stomach got off the ground.

We bounced through some clear-air turbulence and th F-94 shuddered. When she settled down, Herb said, "Are yo all right?" and someone answered for me, "Affirmative."

"Okay," said Herb, "let's try one. Remember, I'll div climb, fly the arc and haul her out. We'll pull a lot of Gs a the beginning and the end."

At 4.40 p.m. we were at 20,000ft boring through th Texas sky at 400 knots. Herb nosed her over. The sk disappeared upward and the F-94 dropped like a streamline stone. Then, before I was ready, he hauled back on the stick It felt like someone was piling Sequoia logs on my shoulders my back, my head. Then, from somewhere in the distance, heard the afterburner cut in and I knew we were rocketin almost straight up.

"Here we go," yelled Herb.

ANOTHER WORLD

And I slipped into another world, a world of delicately blurred sights and sounds. The cockpit was pleasantly hazy the roar of the engine agreeably muffled.

I noticed my feet were off the floor and that my body was floating upward ever so lightly against the seat belt. I was on a real champagne kick.

I thought, don't let it ever end . . . and a pile driver smashed me down into the seat. We had indeed pulled a lot of Gs as Herb brought us back level.

When I came back up for air, I said, "How long were we weightless?"

"That was a shorty," he said. "About 25 seconds."

I knew then that while we were weightless I had lost my sense of time. I felt the way you do when you're just about to drop off to sleep and you come back to full consciousness with a start.

The next one was as pleasant as the first. I was floating, and everything inside me was floating. I was happy as a kid on Christmas morning.

I laid my pencil on the palm of my hand and gently let it go. The pencil floated away. I laughed and reached for it, but my weightless arm overshot. Accidently my fingers brushed the pencil, but it did not fall. I felt as though I had made a great discovery. I wanted to catch the pencil and throw it up in the air and yell with joy . . . when the pile driver hit me again.

"That one was better," said Herb. "About 35 seconds."

I ASK FOR MORE

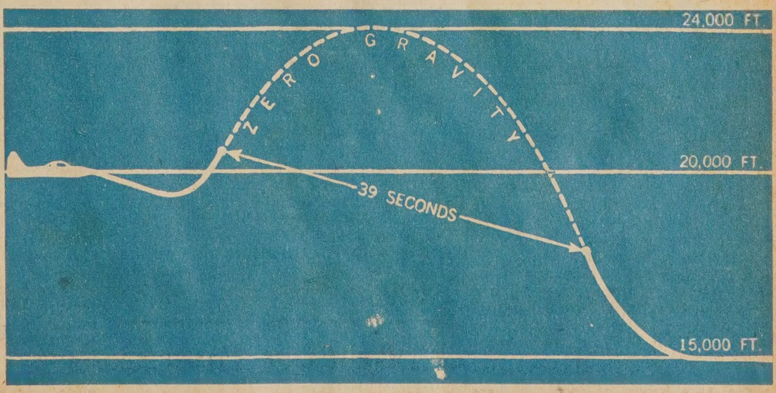
"Let's go for the record," I said. "I've got to get serious and do some work. I've got to act like a spaceman."

My watch read 4.58 just before we went down again. During this parabola, I closed my eyes. I was on the same kick, everything light and happy, but suddenly I felt as though I were rising out of my seat. I opened my eyes quickly, fearful that my harness had slipped loose, but it was still there.

I closed my eyes and drifted slowly upward once again. This time, I kept them closed and began a gentle forward somersault. Up and over I drifted until I opened my eyes

☆

HOW ZERO GRAVITY WAS ATTAINED: Sketch traces trajectory followed by the F-94C Starfire from level flight through the parabolic arc that induced weightlessness for nearly 40 seconds.



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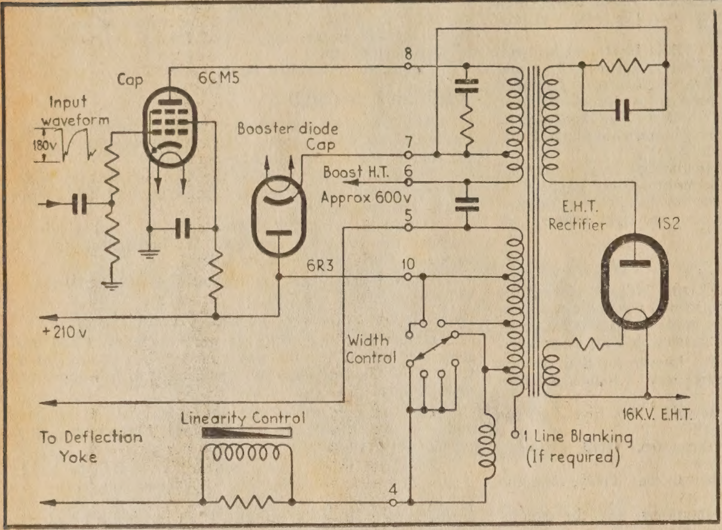

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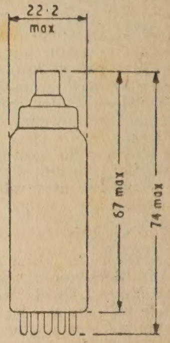

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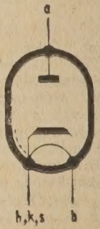

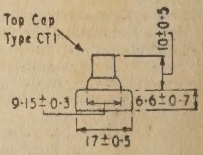

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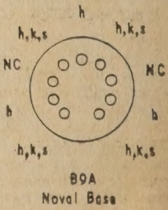

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TYPICAL OPERATING CONDITIONS

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D.C. output current	150 *μA*

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and all the parts of the world scrambled back into their proper places. Sleep on a spaceship, at least for me, will be a long tumbling ride through nothingness.

"Pretty good that time," said Herb. "Almost 40 seconds."

"Do you feel these strange sensations?"

"Not too much. When you're busy, you don't have time to notice. And watching the instruments keeps you oriented."

We augered down toward Randolph, bucking and skidding as the dive brakes fought to keep us from lunging straight in. At 3,000ft we levelled off, and Herb popped the wing flaps. In seconds the F-94 was tamed and we were sitting down hard but smoothly on the long east runway, with our brake chute billowing behind us. I glanced at my watch again — 5.17. It seemed to me that a lot had happened in one hour.

Back at Dr Gerathewohl's office, I talked to Dr Julian Ward. "What's the big problem," I said, "if you can find space pilots who get a bang out of this the way I did?"

TIME FACTOR

He told me that being weightless for days or weeks may be quite different from being weightless less than a minute. What's more, the medics don't know yet how zero gravity will affect the heart and other large organs or the blood pressure. They are concerned about the effect on our reflexes. Drop a cat upside down on the ground and he'll land on his feet. After 15 seconds of weightlessness, he can't do it.

Most researchers believe that a carefully selected, well-trained crew will not become airsick in space. Only about one out of three subjects get violently sick in the F-94, and some doctors link their sickness with the sudden change from high positive G to weightlessness.

But the researchers are worried about the effect of zero gravity on co-ordination and muscular control. Most subjects aim too high if they reach for something. Vision is affected; the after-image of a light on the retina tends to drift upward during weightlessness. Eating and drinking are difficult. Sleeping may be a long nightmare. These are just some of the problems to be solved before we can put a man safely into space.

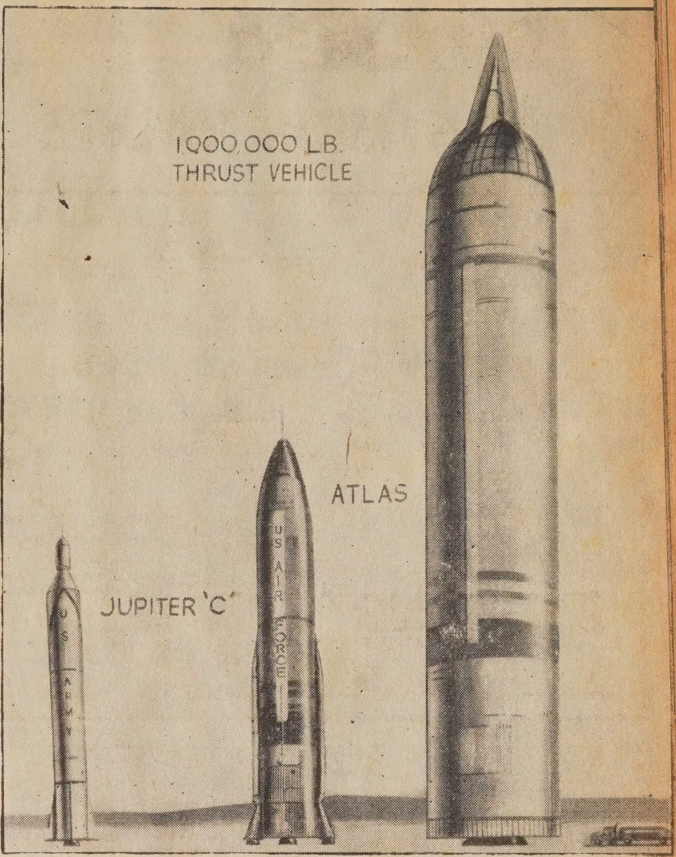
RAINDROP GAUGE

DETERMING raindrop size is regarded by scientists as one of the first steps in weather control. One possibility is that of evaluating artificial rainmaking by distinguishing artificially generated rain from natural rain on the basis of drop size differences.

Chief tool of the investigation is the raindrop size spectrometer, a device that measures and counts raindrops without disturbing them. It consists mainly of wo black boxes mounted at the ends of two arms. One box contains a light ource, the other a photo-cell and amplifier.

As the arms whirl at about three times second, the photo-cell watches a spot in the light beam. When a raindrop asses through that spot, the amount of ght on the photo-cell tells the size of he drop. In the heaviest rain the de- ce records about 50 drops per second.

WORK BEGINS ON A BIG ROCKET



Relative size of missile that can be boosted with a million-pound thrust engine is shown in sketch by artist. An essential step toward interplanetary exploration, the development of a single-chambered engine in the million-pound class will make a cluster of six for a six-million pound thrust relatively easy.

Although many scientists believe that practical outer space travel will not be practicable until large amounts of power which can be released under control for very long periods become available, the rocket engine at the moment seems to be the only practical method of sending vehicles into space.

SUCH motors are serving very well at the moment, and both the Russian dog and the American mouse have been able to survive the initial blast-off.

But sooner or later such brute force methods may prove to be inadequate.

In the meantime the development of bigger and better rocket motors goes on. It is apparent that the Russians have produced some very powerful types, although the American Atlas seems to be the most powerful we know about at present.

It has just been announced that the U.S. Air Force has given a contract to begin development of the major components for a new rocket engine to Rocketdyne, a division of North American Aviation Inc. It is by far the largest such project yet attempted by this firm and is believed to call for a thrust of one million pounds.

Simultaneously the Air Force under separate contract extended development work by the same firm on a previously undisclosed engine which is expected to provide a thrust in the intermediate range between current propulsion systems and the million-pound class. This engine has been under consideration since mid-1955.

Both engines mentioned above use liquid propellants and are similar in principle to the Rocketdyne engines made for the Atlas ICBM, the Thor and Jupiter IRBM, and the Redstone missile that provided the first stage boost for the satellite-launching Jupiter C.

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PORTABLE TV

RECEIVER MODEL P17

THE FOLLOWING IS A COPY OF AN ARTICLE WHICH APPEARED IN A RECENT ISSUE OF THE ELECTRICAL WEEKLY, COVERING OUR NEW PORTABLE TV RECEIVER.

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AERIAL INPUT 300: cascode turret tuner receives 10 channels; parallel valve heaters; twin 5¼" speakers (one each side of cabinet); sound output 3W max. IF's 36MC/s and 30.5MC/s. Extension speaker connection provided.

TOP CONTROLS: channel selector and fine tuning; contrast and volume; horiz. hold, vertical hold and brightness. Preset controls; height and vertical linearity.

All high-voltage points protected. All valves accessible on removal of safety back. Chassis may be removed without disturbing speakers, picture tube or yoke assembly. Clear curved armor-plate safety glass: picture tube unmasked. AGC may be removed from "front end" by simple accessible adjustment for better results in some fringe areas.

All metal cabinet finished in baked enamel; colors, two-tone grey and two-tone blue and grey. Dimensions: 14in high and 17in wide and 18in deep. Nett weight 49 lb. Packed weight 59lb.

(Similar receivers fitted with field strength meter for survey work available to order; price on request). Receivers and vibrator power supplies for use with 32V lighting plants to order.

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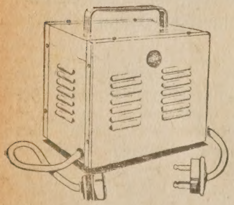

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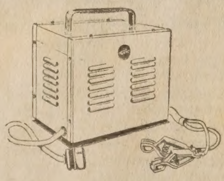

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WHAT WE KNOW ABOUT THE MOON

WE CANNOT SEE THE OTHER SIDE

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WHAT is the moon like? We now know about just one side. Surprisingly, we know that side very well, better than some parts of the earth. Here are the facts: fascinating details painstakingly established, puzzling mysteries waiting for explorers to solve. Embark below for your armchair tour of Moon Number One.

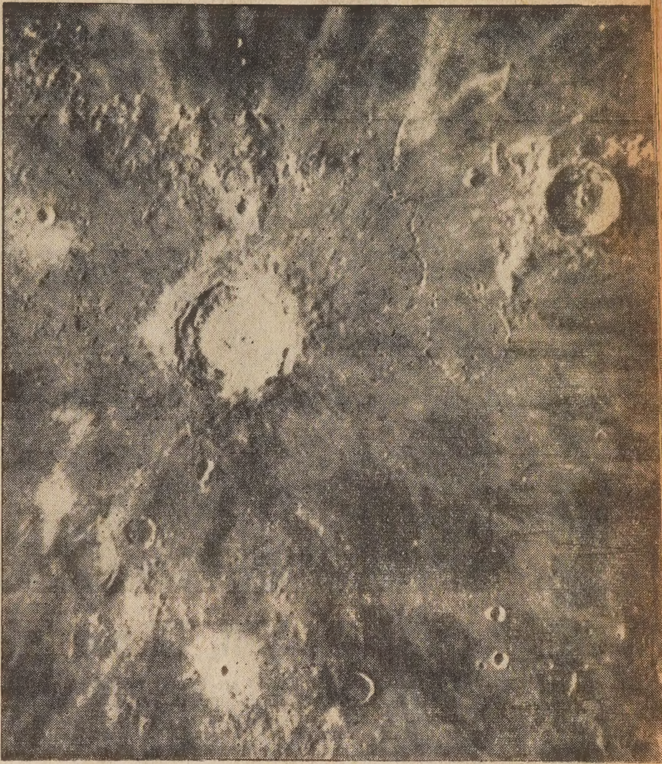
"LEIBNITZ MOUNTAINS. The highest peaks of all, outranking Everest . . . THE SEA OF FERTILITY. One of the larger seas of the Western Hemisphere . . . NEWTON. The deepest of the craters . . ." Absorbed in the scenic wonders described in your guidebook, you may be unprepared for an outstanding impression of your first visit to the moon.

THE POWDER

That's the powder. A blanket of it covers everything, even steep slopes of jagged mountains. Perhaps a foot deep, the glassy stuff yields underfoot like quicksand, and you must learn the knack of getting around in it. Static charges make it cling to your space suit and the window of your space helmet. Although fine as face powder, it isn't like dust, since there's virtually no air for it to float in. It's an odd sight to see the powder settle instantly, after you stir it up by wallowing through it or by skiing over it.

What's on the moon—the powder and the rest—will become firsthand experience as soon as rocket ships begin plying outward from earth's man-made space stations. For it stands to reason that our nearest celestial neighbour, whose average distance is only 238,857 miles, will be the first one visited by spacemen. So declares a British astronomer, Patrick Moore, secretary of the British Astronomical Association's lunar section, and a leading member of the British Interplanetary Society.

His book, "A Guide To The Moon," offers would-be voyagers to Luna, by elescope or spaceship, a veritable travel manual. Places they should visit, and sights they'll see, are described in the light of recent findings.



The face of the moon has been painstakingly mapped. To our powerful telescopes it appears only 24 miles away. But what is on its other side? We have never seen it.

Pointed out, too, are mysteries of the moon that may be fully solved only when the first rocket ship blasts down to a landing: Is there life on the moon? Has it any atmosphere? Are volcanoes still active? What's on the other side?

Today, these questions remain unanswered, even though the face of the moon that is turned toward us has been mapped better than the interior of Greenland. To an observer at the world's most powerful telescope, the moon appears only 24 miles away. The best photographs of its rugged and pitted surface reveal details only a few yards across. Enjoying such an excellent view of the moon's 2,160-mile-wide disc, astronomers have discerned more than 10,000 different features.

NO WATER

Upward of 700 of the most prominent ones have received names. The moon's "seas," "oceans," "bays," and "marshes" once were believed to be sheets of water. Today we know there's no water on the moon, and these great dark areas are vast plains—but early observers' fanciful names for them have stuck. Craters bear the names of scientists and other notables, past and present, with mythological characters thrown in; and some mountains are named after famous ranges on earth.

If explorers were ready to start for the moon today, they could take along splendid maps of these surface features. Probably the best, by Dr H. P. Wilkins, British astronomer, was published in a 100-inch-diameter edition in 1951.

And an expedition might do well to carry the latest maps. For astronomers no longer consider the moon, as they once did, a dead and changeless world.

That view was held by the two foremost lunar observers of the nineteenth century, Wilhelm Beer and Dr Johann Madler. They completed a lunar map and a book on the moon that were masterpieces of thorough work. Then they quit. Why observe the moon further?

Thirty years later, however, an astronomer looked in vain for a deep six-mile-wide lunar crater called Linne that had been well known to them. Linne had vanished. Where it had been, there was only a white patch, which marks the spot to this day. The most likely guess of many is that landslides, triggered by a "moonquake," caved in the crater's walls and destroyed it.

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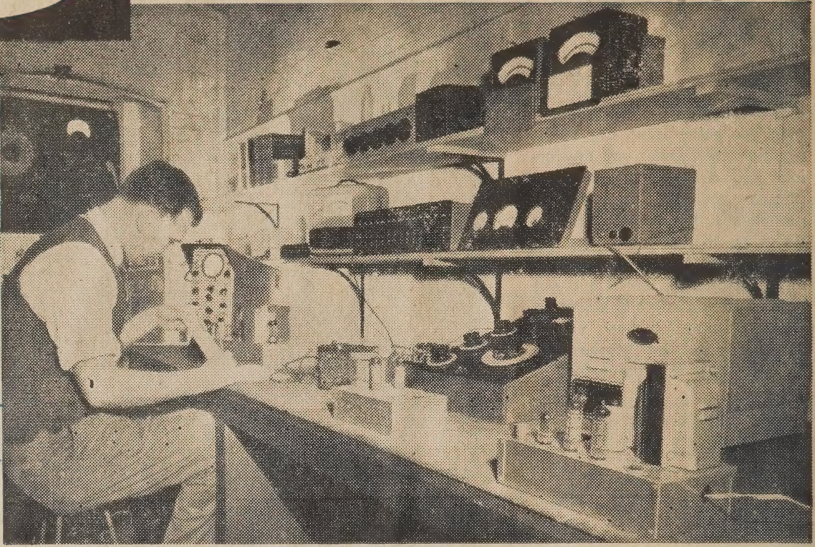

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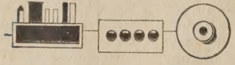

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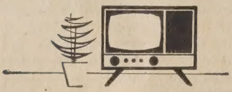

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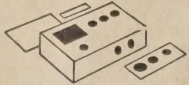

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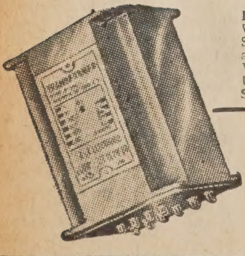

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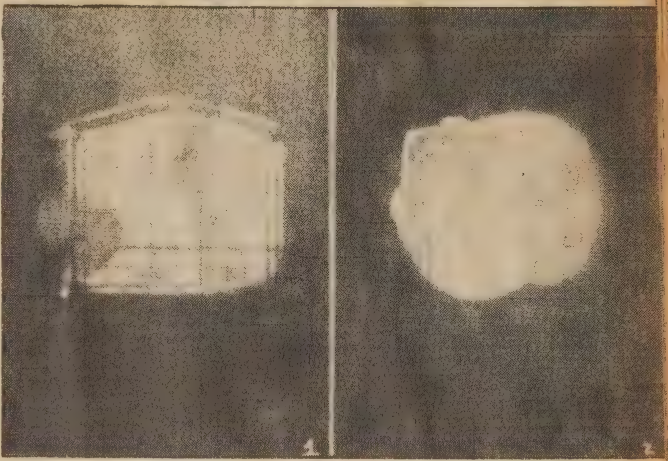
BIRTH OF ATOMIC EXPLOSION



These pictures, recently released by the U.S. Atomic Energy Commission, are believed to be the first which show the birth of an atomic explosion, and were made at Nevada with high speed equipment. Left photo at one-millionth second exposure shows the start of the explosion in the cab at the top of a steel tower. Right photo, one-millionth second later shows the fireball emerging. One instant later, blast destroyed the camera and seared hundreds of acres. How record survived has not been disclosed.

Imagine a moon explorer witnessing such a cataclysm at close range—cliff falling away, the lunar landscape changing before his eyes It would be all the more awesome because it would happen in silence—there cannot be enough air on the moon to carry a whisper of sound.

Close observers have since found other mystifying developments on the moon. In 1939, Moore, the author of the lunar guidebook, himself observed a dense fog that filled a whole crater with a whitish mist. With no water to form clouds, what could the mist be? Carbon dioxide seems a reasonable guess to Moore. And since this gas is given off in volcanic eruptions, mists seen by him and others may mean the moon still has active volcanoes.

The most remarkable object on the moon, perhaps, is the 29-mile-wide, 5,000-foot-deep crater Aristarchus. Its central peak is the moon's brightest spot, even shining starlike after dark by reflected light from the earth. But still more interesting are dark bands, radiating like spokes from the central peak to the outer walls and up them.

BANDS WAX AND WANE

Mysteriously these markings wax and wane. They darken progressively outward after sunrise—then shrink and fade toward the end of the weeks-long lunar "day." Through a powerful telescope, the grey-bordered dark streaks resemble the "canals" of Mars.

Then is there life on the moon—as the famous canals on Mars too may be signs of life? Along surface cracks of volcanic origin, Moore suggests, a primitive form of lunar vegetation—lichens or mosses—may develop under the sun's warming rays and revert to dormancy during the bitter-cold period of darkness. Volcanic carbon dioxide gas leaking from the fissures might sustain its existence.

A lunar newspaper would have had sensational news to report in April, 1948. A tiny brilliant flash of orange-yellow light was observed then just within the crater Plato. It must have marked the impact and explosion of a great meteorite—perhaps as big as the one that struck Siberia in 1908 and levelled trees 20 miles away. A few similar observations are on record.

But the most interesting thing about them is their extreme rarity For if the moon had no atmosphere at all, it has been calculated, the flash of a 10-pound meteorite's impact would be visible from earth with the naked eye, and about 100 such flashes would be seen yearly. Since we don't, is the moon totally "airless?"

LITTLE ATMOSPHERE

That the moon can have no more than a trace of atmosphere is evident from the usual absence of a lunar twilight (rare exceptions have been reported) and the lack of refraction or light-bending when the moon's edge obscures a star. But an atmosphere 1/10,000 as dense as the earth's, at surface level, could escape detection by such tests. Even so slight a trace—which does exist, recent optical experiments suggest—would have tremendous consequences.

Imaginative accounts have pictured lunar explorers bombarded with death-dealing meteorites, and forced to take underground shelter. But a trace of atmosphere would suffice to form a "meteor screen" and burn up most meteors before they reached ground, as on earth. The rarity of observed flashes tends to confirm that this is just what happens.

Powerful ultraviolet rays of sunlight, another hazard anticipated for spacemen on the moon, may likewise be filtered out by a lunar atmosphere. But still it must be so rarefied and devoid of oxygen as to be useless for breathing; explorers must bring oxygen along.

BLACK SKY

Space suits and above-ground living quarters must be insulated against violent extremes of heat and cold—the moon's surface temperature soars to 214 degrees when the sun is overhead, and plummets to 250 degrees below zero at night. Enduring such rigours may seem inconceivable to an earthman—but on the moon, temperature loses its accustomed meaning, as there is practically no air to imprison you in a stifling blanket of heat, nor to drain the body's warmth with polar gales.

A voyager disembarking upon the near side of the moon, and looking upward whence he came, will see a perpetually black, star-studded sky. The glowing earth—four times as wide as the moon looks to us—always hangs overhead, swaying only a little to and fro. And the sun, a blazing beacon, journeys so leisurely across the heavens that a day is about 29 times as long as on earth.

In the sun's glaring rays, the lunar landscape will look as unreal as stage scenery under klieg lights — dazzling highlights, black shadows. Explorers will need their courage to explore craters that reach 183-mile width and 29,000-foot depth.

Rising like an island from the flat lava floor of the Ocean of Storms Majestic Copernicus, "Monarch of the Moon," measures 56 miles from crest to crest. Its ridged and gullied outer slope is a gentle one, and can be climbed with little exertion, since a 150-pound man weighs only about 25 pounds on the moon. From its crest some future Daniel Boone may look down 17,000 feet, past masses of tumbled rock, into an inner amphitheatre as large as Rhode Island.

But when an explorer reaches the bottom centre of a crater floor, the outer walls may seem to have shrunk or even vanished completely. Why? Because the moon's curvature, much sharper than the earth's, will sink most or all of the towering ramparts below his horizon.

Lunar mountains surpass anything on earth in wild grandeur. For lack of any sea level with which to compare their altitude, it must be compared with nearby terrain. Loftiest of all by this standard, the Leibnitz Mountains near the south pole soar 35,000 feet, more than a mile higher than Mt. Everest.

CONTRAST WITH EARTH

Strange and varied formations await sightseers: "Clefts" or gaping cracks in the ground, surface swellings called "domes," and unexplained whitish "rays" extending from some craters—perhaps streaks of volcanic ash from the last explosions of dying volcanoes. Impressive indeed will be the Straight Wall in the Sea of Clouds—a sheer 800-foot cliff, 60 miles long. Its nearly vertical face remains blistering-hot after the ground has cooled: It gets the setting sun's rays head-on.

Vividly the scenes will contrast with earthly landscapes — for these gaping craters, these jagged mountains, have been untouched by wind, rain or frost.

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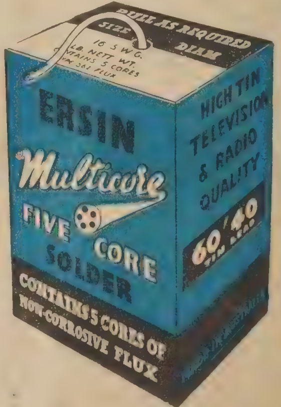
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NEW APPROACH TO BABY PLAYER

FULLY AUTOMATIC PLAYER

The use of transistor amplifiers and motors with a very low power consumption has enabled extremely compact record players to be produced.

AN English company has started to make a gramophone which fits inside a box 8in by 4in by 1in—completely.

Getting it down to that size involved planning to make the mechanism as compact as is compatible with efficiency. It also raised the question of what to do about the turntable.

The design does away with a turntable altogether. The record is simply set on a rubber spindle set into the lower part of the gramophone box. As the lid of the box comes over a nipple in the lid meets this spindle. Two rubber-tipped shafts come into contact with the underside of the record to communicate the motor's impulse to it and keep it turning. A 12in record will fit. The box is just long enough to give it adequate clearance of the hinged edge. The lid is also designed to give vertical clearance for the record when the lid is shut.

The folding arm for the pick-up comes over with the lid, making contact with the record as the lid is closed. When not in use the arm fits snugly as part of the lid.

SIX-VOLT BATTERY

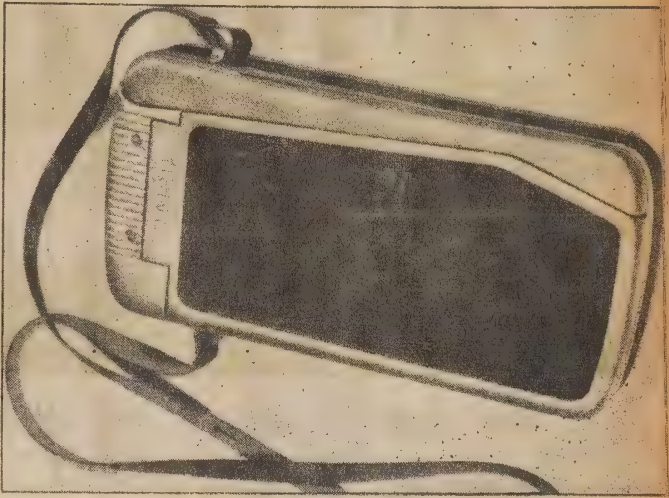
A six-volt battery drives the motor, and serves the amplifier which energises the speaker. The amplifier uses transistors.

The motor had to be specially designed with an eye to size, reliability and low drain. A governor is incorporated so that the record speed can be kept constant even when the batteries run down.

The company—Camp Bird Industries, of London—has given no estimate of how many hours of running the battery will have. Its chairman, Major C. Collaro, says: "Apart from reducing both the cost and bulk of a gramophone to a degree which I would have thought impossible as an engineer, I regard as the greatest achievement the improvement in performance. Working parts are reduced to only two—whereas no other gramophone or record player now has less than 20 moving parts. The elimination of weight and friction in the mechanism will mean less drain on the tiny batteries."

The speed can be adjusted to play both 33 and 45 r.p.m. records.

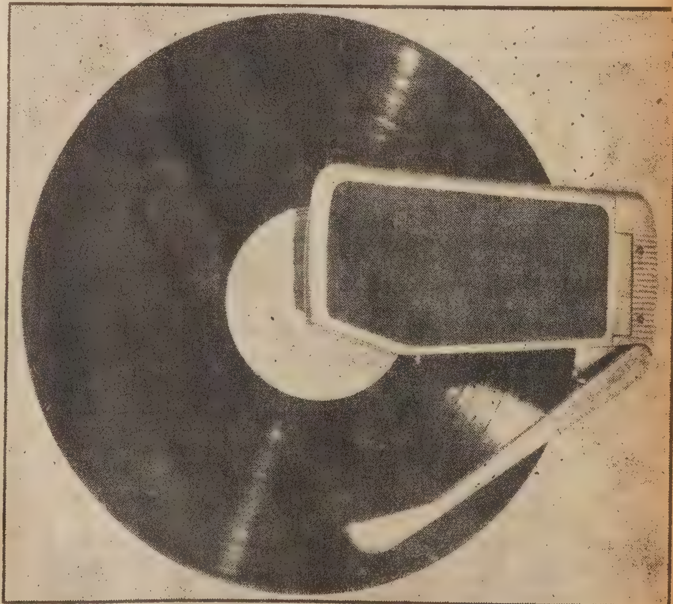
The company has organised new production lines on a fully automated basis for the manufacture of the gramophone, which it will market under the name of the Wondergram.



A photograph of the player closed after use.

It is preparing for big sales in the United States at a price provisionally estimated at 20 dollars (£A8/18/-). It has not announced plans for the English or Australian markets, though England may see the first models on display within a few weeks.

It is also trying out a similar miniature record player to be attached to a ordinary radio and work through th mains. This will be far less bulky tha the conventional record-player and cor siderably cheaper. Major Collaro estimates that when it is ready to produc its cost of production may be as low a £1 sterling.



The player with a 12-inch record in place.

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Mantel Receivers							
Little General	April, 1957	U or F30/150	230/240	30	150/150	6.3v/1.7a	Midget U or F
3 Band Rx	August, 1957						
Any standard mantel Rx		U or F40/285	"	40	285/285	6.3v/2a 5v/2a	Upright or Flat
		U or F40/325	"	40	325/325	6.3v/2a 5v/2a	Upright or Flat
		U or F50/225	"	50	225/225	6.3v/2a	Upright or Flat
Radiograms							
Economy 5	Sept., 1957	U or F60/285	230/240	60	285/285	6.3v/2a 5v/2a	Upright or Flat
Economy 5	Dec., 1957						
		U or F60/325	"	60	325/325	6.3v/2a 5v/2a	Upright or Flat
Std. Gram.	May, 1957	U or F80/285	"	80	285/285	6.3v/2a 6.3v/2a 5v/2a	Upright or Flat
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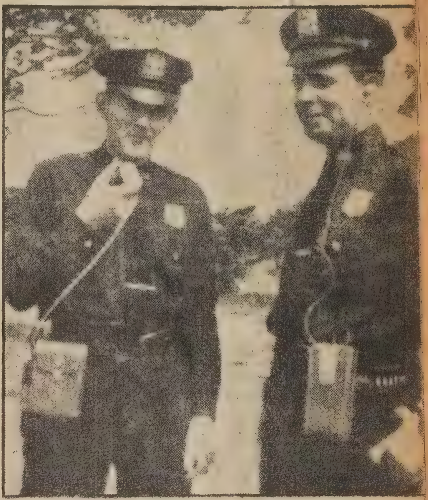
BELT RADIO HELPS FIGHT CRIME

THE New York Police Department operates what is probably the largest and most extensive two-way radio service in the world, involving nearly one thousand vehicles. In addition it receives and clears not only the constant stream of police messages, but all ambulance calls as well, many of which have a direct association with crime. The task of tagging eight million people would not be possible without radio, and in the near future an added facility is likely to extend its usefulness.



Two New York policemen testing the miniature radio telephone—the transmitter at the left and the receiver at the right. This picture emphasises the compactness of the equipment.

SOMETHING new is being added to the belt of the cop on the beat—a miniature radio station to keep him in constant touch with headquarters.

The foot patrolman long has been on his own between telephone call boxes. Reaching a fixed point of communication can be a time-consuming operation in an emergency, drawing the policeman away from the scene of action.

Now radio engineers have come up with a compact solution in the form of a small receiver and accompanying transmitter which the crime fighter straps on his belt beside his service revolver and other tools of his trade.

The R.C.A. Personalphone has aroused the interest of public safety officials, including the police department of New York City.

PATROL PROBLEM

One of the problems facing New York's "Finest," has been patrolling the city's sprawling park system, all 34,000 acres of it.

New York Park Commissioner Robert Moses has announced that by the end of this summer police patrolling the city's large parks will be equipped with pocket-size radio equipment as part of a concerted drive on crime.

If the user is to remain mobile, such equipment must be extremely small and light in weight. Intensive miniaturisation has wrought miracles in this field, and transistors are and will be adding very greatly to the achievement of the same end. Recent developments have extended the frequency range of transistors very greatly and although no technical details reveal how they are used in this equipment, they have provided the key to success. Otherwise it would scarcely have been possible to reduce battery weight to the figure given.

A lapel-type speaker or an ear plug version can be used with the receiver. In either case, the passerby would have to look twice to see that the cop on the beat was wired for broadcasting. The transmitter and receiver may be kept completely out of sight under the policeman's uniform coat.

Only 6½in long, the receiver is slim enough to slide into a man's shirt pocket and weighs just 10oz. Completely transistorised to permit such miniaturisation, it has a receiving range up to two miles in communication with other mobile units and even longer when operated in connection with a fixed station.

The New York police plan includes a transmitter in Central Park at 79th Street.

The plastic case of the receiver is equipped with a clip for fastening the unit to a belt if the leather pouch is not used. On top of the case is the on-off switch and a plug for the cord feeding either a lapel loudspeaker or an earpiece reproducer. The unit is powered by a single small battery capable of operating up to 150 hours.

The miniature frequency modulation transmitter weighs only 28oz with its battery. Approximately the same shape as the receiver, the transmitter is equipped with a carbon-type microphone the size of a silver dollar. There is a push-to-talk switch at the base of the microphone.

Both the transmitter and receiver operate in the 150 megacycle band and will work compatibly with any existing standard radio system.

While police applications of t pocket-size two-way radio have receiv considerable attention, the compa unit is capable of a wide variety of use

Among these are fire department com munications, the radio linking of pla guards and in connection with constru tion projects.

FULL CONTACT

A firefighter equipped with a be radio unit can maintain radio conta with his chief, calling for assistanc where needed and giving his superio an on-the-scene description of condition in a blazing building.

The plant guard encountering out-o the-ordinary situations can summon hel quickly by radio.

The foreman on a construction jo can direct widely separated crews fro a central point.

And the age of Dick Tracy comes little nearer!

A general view of New York's Central Park, the patrolling of which has posed many problems for the local authorities.

Two enthusiastic and decorative ladies show how the humble frying pan may be pressed into service when looking for gold.

Gold Is Where You Can Find It

by Calvin Walters

The value of minerals becomes greater each year as more uses are made of them in research and production. Even the uninitiated can often combine a holiday with some prospecting to provide entertainment and profit. Lately I have been taking a hand in the search for gold.

ALL over the world there are men who suffer many privations in their search for gold and other minerals.

They travel vast distances into the wilds and jungles, over and into remote mountain regions infested with all kinds of fearsome creatures and insects, disease and death, searching for that everlasting bag of gold at the end of the rainbow.

Have you ever been prospecting? I don't mean the kind outlined in the last paragraph but the easy kind which is open to everyone who owns a vehicle to travel in.

Last Queen's Birthday weekend my brother-in-law named Bill kidded us to have a go at prospecting round Blayney way. So on the Saturday morning we threw our bags into the back seat of the car, an act which they bitterly resented. We thought they would be more comfortable in there where they could nag to their hearts' content without interrupting the plans of we scientists in the front seat. We put our luggage in the boot.

When we got to Blayney the temperature was about 40 degrees below zero and it was raining. Undeterred by this, we hied to Trunkey Creek with the enthusiasm of the gold rush days. Here Bill said that we could have a try, panning for gold in the creek.

Bill got out a funny-looking pick and a couple of tin dishes. He said that all you did was to stand in the water, get a dish full of mud and wash it around thus and thus. Any gold would sink to the bottom and there you were. After wallowing in the mud for half an hour with the water threatening to turn to ice any minute I got a bit fed up, picked up the tools with my numb fingers and scooted to the Black Stump Hotel for a glass of hot water to warm things up a bit.

Back at Blayney it was snowing to make the trip more pleasant so we had more glasses of hot water and went to bed.

On the morrow through several feet of snow we ploughed to Sofala. This is about 38 miles from Bathurst and the nearest approach to Tombstone of TV fame that I could imagine. However, there was no sheriff to make things awkward and no gunshots to welcome us.

FOOL'S GOLD

Here we ploughed around in the muck in the river with our dishes and finally I sighted a speck of glitter. "EUREKA," I shouted. Bill said, "Who, ME? It must be the garlic I ate for dinner." I said, "No, I can't smell anything, I mean I have found gold." Don't be silly," said Bill, "that's fool's gold"; a very insulting remark I thought until he explained that it was mica.

I said, "What do you do if a snake comes at you, throw stones at it?" "Don't be silly," says he. "Never throw stones away until you crack 'em open. If it is quartz it might have gold in it. If it is black and heavy it might be chrome. If it is a lead colour it might be silver. If it is . . ." but by this time I was wondering how you would crack stones open with a black snake hanging to your deltoid muscle.

To cut it short (I can see the Editor getting impatient) we got nothing but leeches in our shoes, frozen fingers and a cold in the head which was compensated somewhat by the cosy warmth and hospitality at the pub at Sofala.

I found out later that we were fossicking in the wrong place. If we had gone round the bend we would have got a dishful of gold, but they didn't say which bend. It is the same as going fishing. It is always too sunny, too late, too early, tide too low, too high, too windy, too calm, and so on.

I don't wish my facetious remarks to deter other enthusiastic prospectors. With the right gear at the right time of the year you can get a lot of fun out of it. There are many people who spend their vacations in this manner. The Department of Mines in any State will tell you where to try your luck and, believe me, even the wife and kids can spend a pleasant holiday in this manner.

All you need is a special pick and some special dishes, a pair of rubber boots, a couple of full demijohns and a 40-gallon drum to put the gold in in case you are lucky.

Large-scale prospecting is done in a very different manner and Governments and private companies spend vast sums every year in an effort to find the precious minerals so vital to a nation's economy.

The first step usually taken in large-scale prospecting is to use aeroplanes for aerial reconnaissance.

Notwithstanding the presence of large jungles and forests, outcrops of reefs, subterranean watercourses and the like can be readily seen because of their influence on the growth of vegetation.

VEGETATION CLUE

The reef or lode itself may not be visible, but in most cases a line of vegetation will be clearly visible along the line of the reef because there the trees will not root freely. In the case of subterranean water courses the vegetation will be greener along the course of the stream.

On open areas the different moisture contents of the soil show up as various discolorations and the colour of this may, in turn, indicate the type of mineral likely to be present.

From the air it is easy to map out all the features of the country. Contour maps are prepared which show every bend of a watercourse and the type of country bordering it. As well as indicating the kind of stones and outcrops, aerial survey can show the most likely routes which a ground party can follow to gain access to the areas.

There are other methods of prospecting the geophysical method, the gravitational method, the seismic method and so on. These, however, are ancilliary to the aerial and ground prospecting methods and are used mostly in prospecting for oil.

The minerals mostly sought after are antimony, arsenic, cadmium, bismuth, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, molybdenum, nickel, silver, rutile, tungsten, tin, uranium, zinc and special clays.

There is an old saying that "Gold is where you find it." This has a wealth of meaning from the psychological aspect and is equally true in the case of the metal. Gold has been found in the most unlikely places and it is this which gives a great stimulus to the prospector.

EQUIPMENT

The small prospector with his simple equipment is just as likely to "strike it rich" as he with the most elaborate equipment.

What, then, does a prospector need and what does he do with his equipment?

As mentioned previously about the only tools needed are the prospector's pick, a couple of prospector's dishes, a mate to argue with and shout Eureka, and a couple of demijohns.

It is of course handy to know the gold bearing areas of a country as this saves a lot of time.

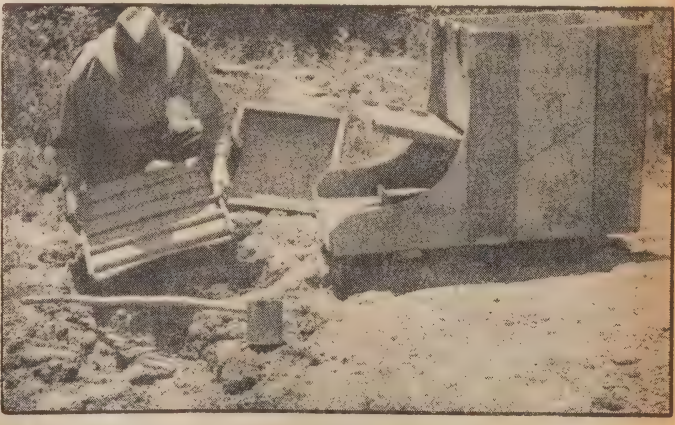
The methods and equipment used for gold are equally useful when prospecting for tin, copper, lead, zinc, tungsten and so on except that the methods used for final recovery are different.

As the Editor will not allow me space enough to outline the lot I will confine my remarks to what a prospector does with Gold.

The most favoured place for a prospector to look is in the beds of rivers, as, during the course of centuries, gold is washed down from "them thar hills" into the river where, because of its great weight, it sinks into the sand and mud of the bed of the river.

AN OLD TIMER TRIES HIS HAND

More authentic than the holiday-makers opposite is this old prospector investigating the possibilities of a creek bed. Not recommended for rheumatic joints!



The gold digger's cradle for washing dirt. The tin tray in the background is put in at the top. The other wooden corrugated trays slope in opposite directions. The tin is used to pour the dirt into the cradle.

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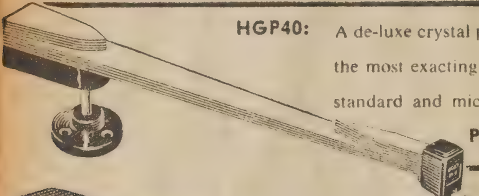

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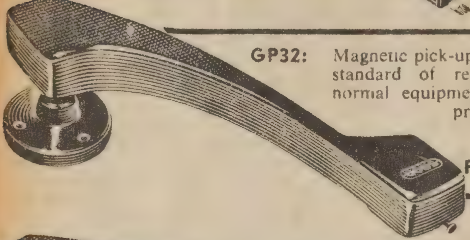

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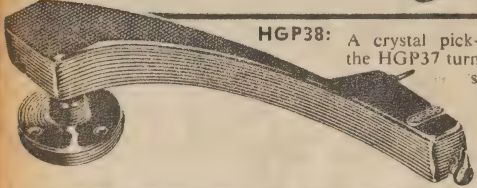

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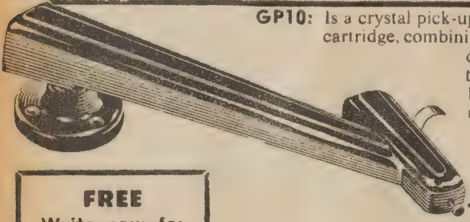

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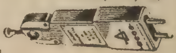

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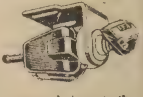

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An experienced prospector will take a careful "eye" survey of the course of the river. His experience has taught him that, when the river is running well the water will flow around curves in such a way that if the river curves to one side, the water will flow straight to the opposite bank. The curve will gather deposits of sand and silt in which the gold (if any) settles.

Here the prospector wades into the sand, mud and stones, after depositing his demijons in a convenient safe place on the bank. Accompanied by the hilarious laughter of kookaburras, the coarse grunts of goannas and the hissing of snakes, he shovels the deposit into the dish. If it is all gravel the dish is half filled with it and covered with dirt and water. (Add a shovel to the list of tools).

DISH MANIPULATION

The dish is now tilted and given a circular motion. The muddy water and all the light material flows over the edge. About an inch of the gravel is now scraped off the top and more water added. All this time the heavy gold (if any) is sinking to the bottom. The process is repeated until only about a half a cupful of dirt is left in the dish. It is here that the process is altered a bit. Instead of using a circular motion the dish is tilted and moved to and fro so that each forward movement washes a little more sand out of the dish.

From here on the eyes bulge, the heart beats faster and a flush appears on the cheeks for when all you have left in the dish is a little black sand, the gold, if any, will be at the bottom. If there is none the prospector curses loudly, throws down the tools and has a swig at the demijon. If there is gold he pretends there isn't in case someone is looking, and has two swigs at the demijon.

But he never gives up. He moves from place to place until he either strikes it rich (whereupon he travels to the nearest big town, spends up big, does his "dough" and starts all over again), or, if he never has any luck, he spends his life wading up and down rivers, grows web feet and lives on witchetty grubs and damper.

Now suppose he finds gold. If he is energetic and the gold is in sufficient quantity he will stake out a claim. In this case he starts a gold rush. Before he knows it, there are thousands of people standing in the river, but he is safe within his claim.

THE CRADLE

He builds himself a cradle, a wooden mechanical device with which he can wash twice as much dirt in an hour as he could in a day with the dish.

The cradle consists of a hopper at the top into which the "pay dirt" is shovelled. Water is poured into the hopper and the cradle rocked. The bottom of the hopper is perforated and the fine dirt and gold is washed through. It falls onto a series of sloping trays which have a lip at the lower edge. These lips catch the gold.

There are other gadgets which are used. The "puddling box" consists of a hollow log sealed at the ends, or a similar device made of galvanised iron and looking like a little boat. It is used to remove clay from clayey "pay dirt." The dirt is mixed with water and puddled around. It is left to settle and the clayey water run off. The dirt left in the bottom is then run through a dish or cradle in the ordinary way.

An interesting method of recovering fine gold from black sand is by the use of mercury. This metal quickly combines with the gold and forms what is called an amalgam.

When the stage of "panning" has been reached where all that is left is fine sand mixed with fine gold, this residue is placed in a glass, earthenware, or iron container and pure mercury added. The mixture is stirred until all the gold has been taken up by the mercury.

WASHING

The black sand and other debris is now washed away by holding the dish under running water. The amalgam stays in the bottom of the dish.

Dirty, greasy gold will not amalgamate with mercury, and is first cleaned in caustic soda or a weak solution of cyanide of potassium. If the latter is used, care must be taken that none gets into the demijon, as it is highly poisonous.

The amalgam is now treated as follows. A moist chamois leather is twisted into a cup and the amalgam poured in the hollow. The ends of the chamois are now brought together and twisted. This forces the excess mercury through the chamois leaving a pasty lump of a mixture of gold and mercury in the chamois.

The recovery of the gold from this is usually carried out by heating the mixture in a retort where the mercury is vaporised and recondensed into the metal and the gold is left in the retort.

There is a simple method used for small quantities of amalgam which makes use of a potato.

A fresh potato is cut in halves and a hole scooped out of the centre of one half. Into this is put the amalgam and the two halves wired together. The potato is then put in hot ashes for half an

(Continued on Page 27)

A WATER JET LOOSENS THE DIRT

More scientific is this method of directing a jet of water under pressure into the side of a creek bank. The water and dirt which make up the stream are picked up by an elevator and run out to a large tray.

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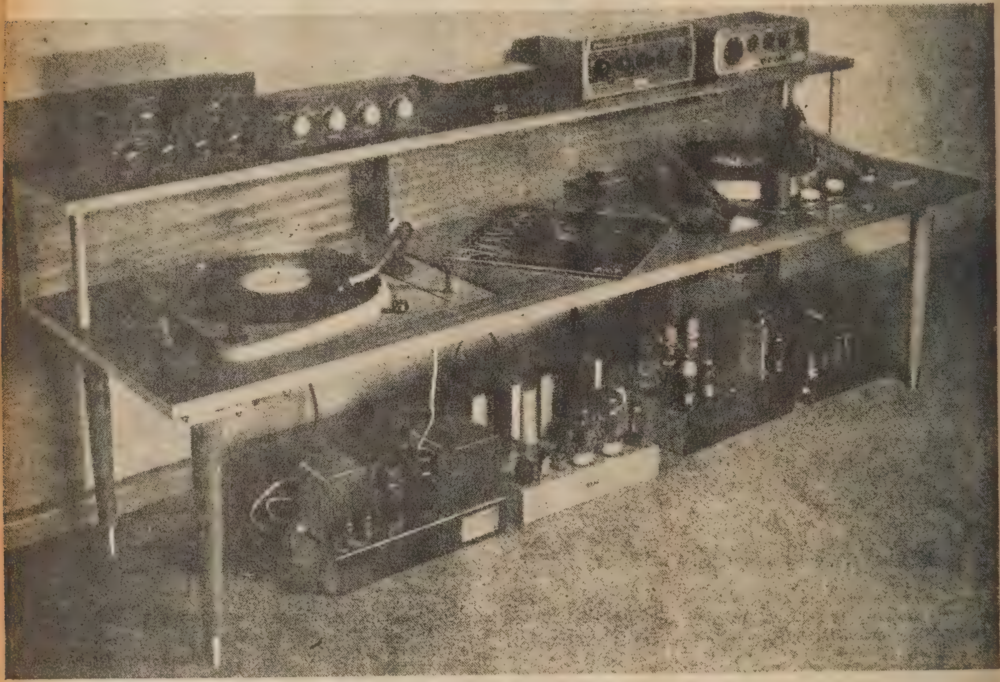

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Technical
Review

COMPATIBLE STEREO DISCS USES MULTIPLEX

Although the gramophone record industry has standardized on the 45/45 stereo system, there are several others which may some day receive further attention, although for the moment their extra complexity has put them to one side. One of these is the Minter system, which uses a 25Kc FM carrier to transmit the difference signal and a standard lateral cut for the sum signal. It is therefore largely compatible with monaural discs.

By Jerry Minter and John MacConnell

MODERN high-fidelity recordings are the product of many man-hours of research, tempered by years of practical experience. It seems logical to the authors to utilise the vast experience accumulated with lateral disc recordings in coping with the problems presented by stereo disc recording, and avoid recourse to any stereo system requiring the development of complex cutting heads and playback pick-ups.

COMPATIBILITY

A basic objective is to make a stereo disc capable of being played monaurally on any monaural phonograph in good working order without sacrifice in performance or damage to the disc. The introduction of such a record would present no inconvenience to those not having stereo equipment, while permitting subsequent inexpensive conversion to a stereo system.

The system described here utilises -m carrier multiplex above the audible pectrum to record the difference information which results when two stereophonic channels are subtracted vectorilly. The vector addition of the two hannels is recorded normally and simul aneously using the standard RIAA urve. The resulting groove resembles normal lateral recording except that there is a super-imposed 25 Kc carrier of moderate level (4 cm/sec velocity).

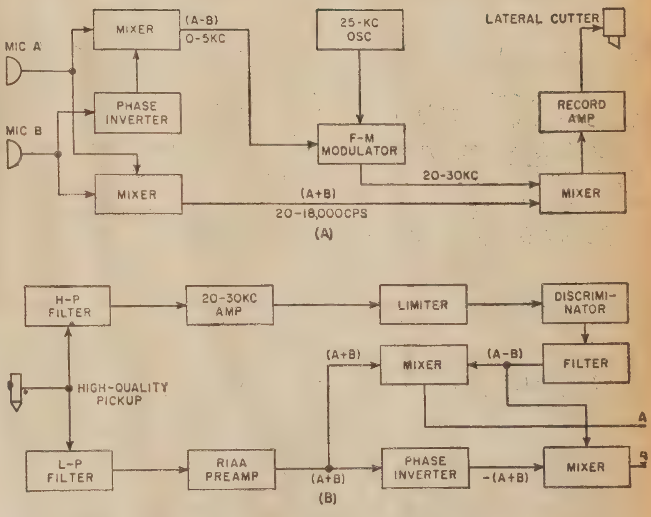

Fig. 1—Block diagram of (A) the recording system, and (B) the playback system. A monaural system could be converted to stereo by addition of (B) and a power amplifier.

Since this carrier frequency is far above the limit of human hearing, it is not audible when the record is played on a standard monaural system. A special auxiliary preamplifier may be arranged to amplify the carrier and its associated sidebands sufficiently for limiting and detection of the audio vector difference signal. After detection, the difference signal must be combined with the vector sum or monaural signal to reproduce the original stereophonic channels.

RECORDING SYSTEM

Reference to Fig. 1A indicates two microphones, A and B, which are placed for stereophonic recording. The outputs of the two microphones are added in phase by the lower mixer to produce a signal of greater amplitude than either signal alone. In general, the added signal or vector sum is the equivalent of a monaural signal which would result if the microphone were located midway between the microphones A and B.

The output from channel B is inverted in phase by passing it through a single stage of vacuum-tube amplification; the inverted or —B signal is then added to channel A to yield the vector difference signal, A—B. This signal contains the stereophonic information and it will be zero (neglecting room acoustics) if the source is concentrated equidistantly in front of the two microphones. The vector difference will increase as sources move either side of centre, thus yielding information as to position of the source.

The A—B signal is fed into an f-m modulator to shift the 25 Kc carrier between the limits of 20 and 30 Kc. The carrier and sidebands are then combined with sum signal A+B in a mixer and fed into the recording amplifier. The recording amplifier and associated lateral cutter are equalised for the RIAA curve up to 18 Kc and flat from 20 to 30 Kc, on a velocity basis.

After the master recording has been

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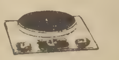

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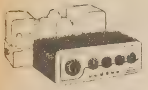

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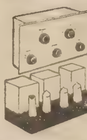

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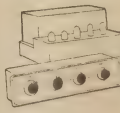

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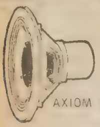

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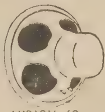

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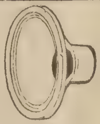

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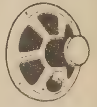

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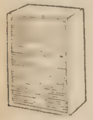

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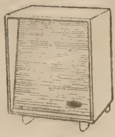

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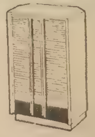

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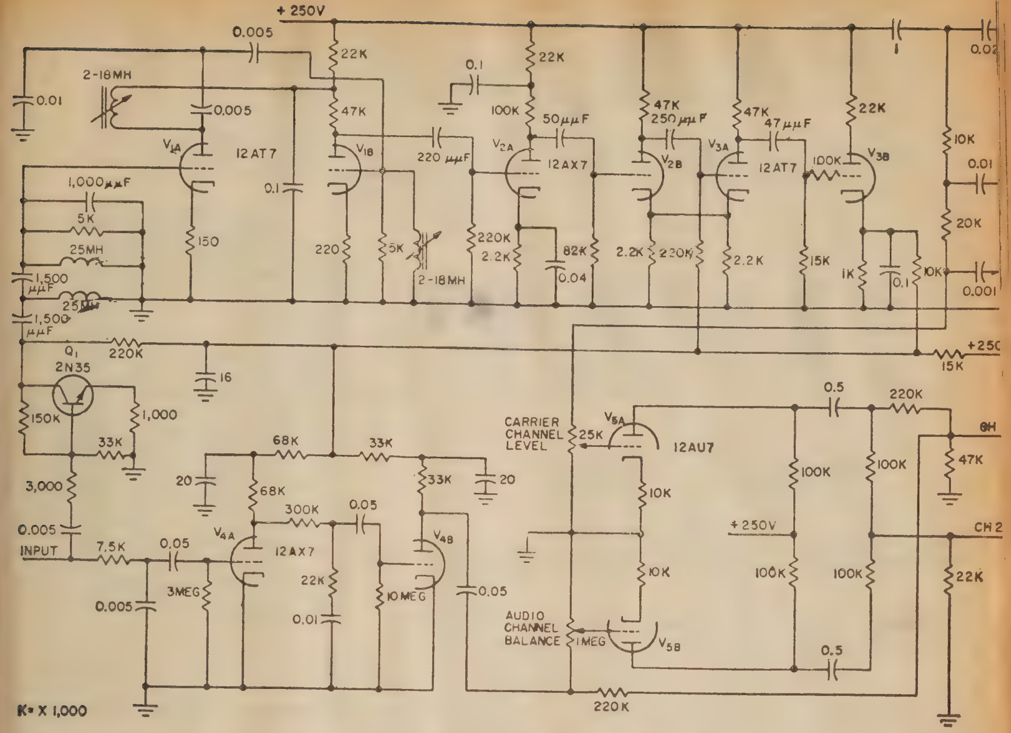
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Fig. 2—Schematic diagram of auxiliary playback preamplifier. Limiting of the f-m carrier is performed by a Schmitt trigger circuit comprised of V2b and V3a. The detected stereo information is therefore in the form of pulse-sampled audio at the output of X3b.

cut, it is processed in normal fashion and vinyl pressings are made in the conventional manner.

There are no special problems associated with this operation.

PLAYBACK PREAMP

Figure 1B is a block diagram of the playback preamplifier. A high-quality lateral pick-up is connected through a low-pass R-C filter to a normal dual-triode preamplifier equalised for the RIAA curve. In addition, the output of the pick-up is fed through a high-pass filter to the carrier amplifer which amplifies the band between 20 and 30 Kc. The amplified carrier and sidebands are passed through a limiter, discriminator and filter to recover the difference modulation A—B from the carrier. This difference signal is then combined with the A+B signal in a mixer to yield the original A signal channel in the output, since the —B cancels the +B. The difference signal and the inverted A+B signal are then added to produce the B signal channel. Both channels are then fed to power amplifiers and speakers.

If only a normal monaural preamplifier and single channel are available, the output of the pick-up can be amplified in ordinary fashion. The high-frequency RIAA roll-off characteristic will remove most of the f-m carrier and its sidebands, which are above the audible range of the ear anyhow.

No detectable noise or distortion results from the presence of the carrier on the disc. The first-order intermodulation products are low and above the audible range of hearing with most types of music. It has not been necessary to lower the l-p recording levels appreciably below that considered good practice (8 cm/sec). Overmodulation of the groove will cause tracking problems and gives rise to tracing distortion.

If severe tracing distortion does appear, and the stylus loses momentary contact with the groove, a carrier drop-out will occur. This can be reduced to a minimum by proper adjustment of the vertical stylus force.

A force of 3 to 4 grams with a 1-mil tip radius seems satisfactory for the several pick-ups used to date.

Some sophisticated circuitry will undoubtedly permit more tolerance in carrier drop-out. This problem bears a resemblance to horizontal TV synchronising problems at the time when phase-controlled oscillators were introduced.

CIRCUIT DIAGRAM

The schematic diagram of the playback system is shown in Fig. 2. The input from the pick-up feeds through a low-pass filter which serves as the RIAA roll-off to V4 which is a conventional preamp. The output of V4 is the A+B signal and it is fed directly to channel 1 and, after phase inversion in amplifier V5, to channel 2.

Another amplifier channel is provided for the f-m carrier through a transistor preamp Q1, and a high-pass filter t V1a which has a double-tuned plate ci cuit to remove extraneous signals fro the f-m carrier and its sidebands. Th stage has a uniform response from 2 to 30 Kc. Stages V1b and V2a provid further amplification of the f-m carrie and stages. V2b and V3a form Schmitt trigger which is used as limiter.

LIMITER OUTPUT

The limiter output is differentiate and fed to counter-type detector V3b which is a high gm triode with fixe bias bled from the B+ bus. The plat current pulses of the counter stage contain the difference information sample at the carrier rate.

It is necessary to filter out the carrier ripples to reduce background noise in the difference channel.

Initially, L-C filters were used. However, saturation of the iron-cored inductors and the high cost of these elements caused a shift to a simple R-C filte which has proved effective. This filter gives some roll-off which can be equalised by pre-emphasis in the difference modulator circuit.

The difference signal, A—B is amplified by V5a and combined with the monaural channel through appropriate resistive networks to form the two stereo channels. The carrier level control is actually a spread control, in that it tends to spread the apparent speaker distance when level is increased. — Electronics.

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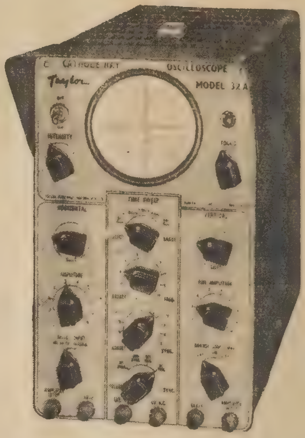

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Sensitivity—80 mV R.M.S. per inch of symmetrical deflection.
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EQUIPMENT FOR INDUSTRY AND RESEARCH

DIVIDED OUTPUT TRANSFORMERS FOR PUSH-PULL

The best method of dividing the audio spectrum in amplifier circuits is still the subject of debate in which many ideas have been brought forward. In general these include the use of a dividing network in the speaker voice coil circuit, and a network in the amplifier circuit itself. Here is another approach in which two output transformers are fed from the same pair of output valves.

By R. GUELKE, Ph.D., M.I.E.E., F.Inst.P.

☆

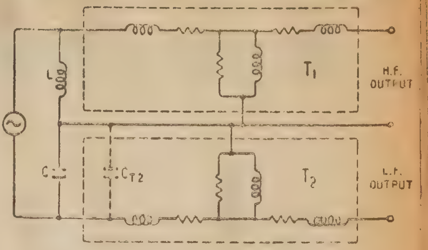
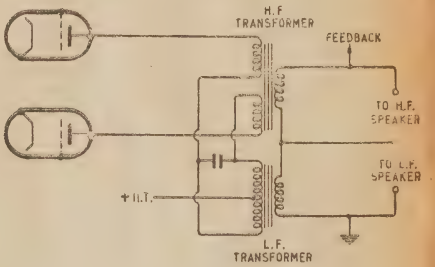


Fig. 1. Right top—Theoretical frequency dividing circuit as described in this article.



THE design of the output transformer for an audio-frequency amplifier of wide-frequency range presents a number of problems. The self-capacity of the primary winding can be high enough to interfere with the working of the transformer at high frequencies. Leakage inductance can also be troublesome at these frequencies, particularly if a considerable amount of negative feedback is to be applied.

It is therefore not surprsing that suggestions have been made that the audio-frequency range should be divided into two regions and two transformers used, one for the high and the other for the low-frequency region; similar to the well-known use of two loudspeakers.

For example, P. W. Klipsch has described a parallel dividing network for separating the two frequency ranges just prior to the output transformers, greater freedom from low-frequency distortion and its intermodulation products being claimed. A well-known manufacturer (Philips) has used two output stages driven by separate valves.

EARLY DIVISION

It is well known that thermionic valve amplifiers are capable of dealing with the entire audio-frequency range without difficulty. It would therefore appear to be unnecessary to divide the frequency range prior to the output valves.

In this paper a circuit is put forward in which the audio-frequency spectrum is divided into two sections prior to the output transformers, but subsequent to the output valves of the amplifier. The output from the secondaries of the transformers can be combined for purposes of overall feedback.

Fig. 1 shows the principle of the circuit. A generator is followed by a simple dividing network consisting of an inductance L and a capacity C in series. This is followed by the equivalent circuits of the transformers, T1 (high-frequency), and T2 (low-frequency). The capacity CT2 represents the self-capacity of the winding of the low-frequency transformer. L and C can be calculated from the following formulae:—

$$L = \frac{R}{2\pi f}, \quad C = \frac{1}{2\pi f R}$$

where R is the load resistance, and f the dividing frequency.

If it is possible to connect two transformers in series, the primary inductance of the high-frequency transformer could be used in place of the inductance L, and the self-capacity of the windings of the low-frequency transformer absorbed into the capacity C

Because the high-frequency transformer would have few turns and also be much smaller than the low-frequency transformer, the self-capacity of this transformer would not be important. The leakage inductance would also be comparatively small.

For the low-frequency transformer leakage inductance and capacity would not be of any consequence, because at the higher frequencies where they become significant the high-frequency transformer would take over. This means that the low-frequency transformer need not be specially wound to reduce this self-capacity. Thus simpler (and cheaper) methods of winding can be used: and as these require less space, the size of the transformer is reduced.

REQUIREMENTS

In order to test the possibilities of this scheme an audio-frequency amplifier was constructed to the specification of D. T. N. Williamson but with the output modified as shown in Fig. 2. It was found that this output stage gave the same frequency response and power output as a standard high-quality transformer if the following conditions were observed:—

1. Any transformer having a sufficiently high primary inductance could be used as the low-frequency transformer. Even standard mains transformers were found adequate using the h.t. windings as the primary and tappings on the mains or l.t. windings as the secondary.

2. The high-frequency transformer had to be constructed of low-loss core material, and the primary inductance adjusted to a suitable value by means of an air gap.

For the high-frequency transformer Ferroxcube was found very suitable as a core material. A core having a cross-sectional area of about 1 sq. cm. was wound with a total of 2,400 turns on the primary (1,200 each side) to make a suitable transformer. This transformer was able to deliver 15 watts at frequencies above 2,000 c/s. With a cross-over frequency of 1,000 c/s and a suitable low-frequency transformer 15 watts could then be obtained over the full audio range.

LOWER COST

The cost of the two transformers is considerably lower than that of a single high-quality transformer because the method of winding is not critical. Furthermore, the high-frequency transformer takes the place of an inductance in the dividing network. The frequency division is carried out at high impedance so that the condenser for the dividing network is smaller and less expensive than usual.

Care has to be taken to obtain the correct polarity for the addition of the two outputs in the feedback circuit. The two primary windings on the high-frequency transformer must also be well insulated because they are subjected to the full primary a.c. output voltage from the low-frequency transformer

For an amplifier which is to be used with a frequency dividing network the use of two output transformers is both economical and satisfactory.

Wireless World.

REFERENCES.

Klipsch, P. W. "Low-Distortion Cross-over Network," Electronics, Vol. 21, No. 11, p. 98. Nov. 1948.

Williamson, D. T. N. "Design for a High-Quality Amplifier," Wireless World, Vol. 53, Nos. 4 and 5, Pp. 118 and 161. April and May 1947.

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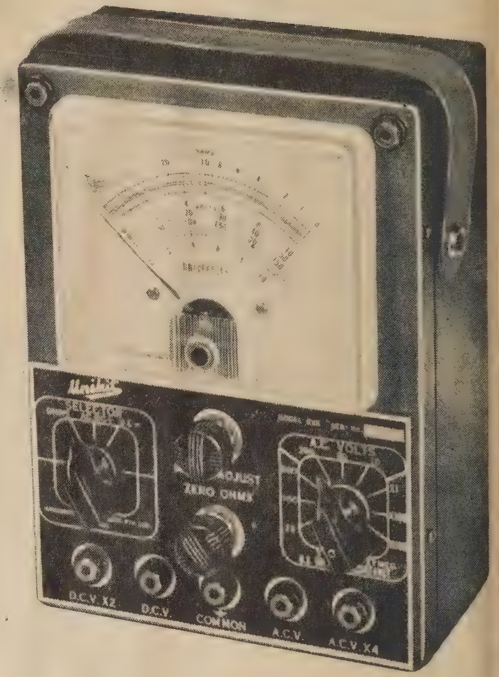

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CAN SEMI-CONDUCTORS BEAT THE HEAT PROBLEM?

Heat remains the biggest problem with transistors which handle appreciable amounts of power, and external cooling devices are used almost universally to protect them. But engineers believe they have not yet exhausted ideas for heat-tolerant transistors.

Semiconductor		Band Gap (ev)	Mobility cm²/v-sec Electrons	Holes	Melting Point °C	Recti-fiers	Transis-tors	Infra-red	Galvano-magnetic	Photo-electric
Diamond		6	......	.....	3,500	✓	✓			
Silicon Carbide	Si C	3	50	10	2,700	✓	✓			
Aluminum Antimonide	Al Sb	1 6	1,200	300	1,080	✓	✓		✓	✓
Cadmium Telluride	Cd Te	1 45	......	.....	1,045	✓	✓	✓		✓
Gallium Arsenide	Ga As	1 35	4,000	200	1,240	✓	✓	✓		✓
Indium Phosphide	In P	1 25	3,400	650	1,070	✓		✓		✓
Silicon	Si	1 1	2,000	500	1,420	✓	✓	✓		✓
Germanium	Ge	0 72	3,600	1,900	936	✓	✓			✓
Gallium Antimonide	Ga Sb	0 7	4,000	700	7,200	✓	✓			
Lead Telluride	Pb Te	0 3	2,000	1,100	920			✓		
Indium Antimonide	In Sb	0 16	70,000	500	523			✓	✓	
Mercury Telluride	Hg Te	0 08	10,000	.....	700			✓	✓	

Some promising semiconductors and their applications.

SEMICONDUCTOR devices rate as prime movers of electronic design and application. Research in semiconductor materials is intended to insure that momentum.

There are several kinds of semiconductor energy conversions which have not been fully exploited—photoelectric, thermoelectric, infra-red detection and Hall effect devices, chiefly.

For example, electronics has lived with temperature problems a long time. In coming years, semiconductors may solve heat-cold complications or, better yet, put them to work.

In addition to frontal assaults on heat with high temperature semiconductor devices, there is considerable interest in thermoelectric devices. Among the possibilities are:

COOLING POSSIBILITIES

Transistor power dissipation: miniature Peltier effect refrigerators built into the transistor. They would cool in proportion to the current, enabling a three or four-fold extension in power.

Equipment temperature control: a combination of thermoelectric junctions could cool when temperature rises and heat when temperature falls.

Perpetual power supply: electricity could be siphoned from atmospheric cold or heat and used as a source of power.

Discussing these and other energy conversions possible with semiconductors, experts in the field say that so far here has been a lot more excitement han accomplishment. The chief drawbacks are size and weight of the devices. More efficient semiconductors are required for practical use other than in electronic circuit applications.

Finding the right semiconductors would be just a question of time. Efforts have gone beyond primary and two-lement semiconductors. They are presently centring the three-element compounds.

Single-element semiconductors, like silicon, have four valence electrons. A ompound with an average of four alence electrons can also be a semionductor. There are thousands of posible ternary compounds in elements in groups 1 through 6.

NTENSE RESEARCH

Researchers have barely begun cataoguing. So far, they have investigated ozens of organic semiconductors and hundreds of inorganic ones.

Research in solid-state devices, stird by the development of selenium rectifiers in 1930 and radar detector iodes during World War II, has been intense since the invention of transistors in 1948. There is a waiting market today for any good new component.

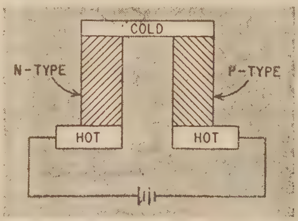
Manufacturers agree that silicon, germanium and selenium devices will dominate the commercial scene for years to come. However, a number of compound semiconductors are being primed for specialised applications.

Interest seems concentrated in silicon carbide, gallium arsenide and aluminium antimonide. These are promising for rectifiers, transistors or diodes which are relatively insensitive to heat.

None is actually new. Until five or six years ago, they could not be made in desired purity or were not recognised as useful semiconductors. Rapid progress in crystal growing techniques has also spurred investigations.

Except for silicon carbide, the compounds have lower melting points than silicon. They have high energy band gaps, however, which permit high operating temperatures before transistor action deteriorates.

One leading firm's co-ordinator of advanced semiconductor engineers rates silicon carbide good for rectifiers and feels gallium arsenide will be fine for microwave diodes. He feels their use in transistors is far away.



Basic thermoelectric design. Temperature difference, up to 80 degrees C. in single units, can be increased by cascading.

An engineering vice-president warns of great difficulty in growing suitable crystals. It is pointed out, though, that these new semiconductors can lead to radiation tolerant transistors operating at 750 C and several megacycles. Silicon carbide device temperature may reach 1,000 C.

Laboratories are making 700 C rectifiers of silicon carbide and 450 C point contact diodes of gallium arsenide. One company recently reported a 6,000-mc gallium arsenide microwave diode and computer switch.

Indium antimonide shows limited promise as a transistor material, but could become important in infra-red detectors. It probably would not require cooling. Electron mobility is high and suitable crystals can be obtained.

Gold is Where You Find It

(Continued from page 19)

hour until it is well baked. When the pie is opened the prospector begins to sing for there in the centre is a button of gold. The mercury is condensed and is absorbed by the "spud" when it can be recovered by squashing the spud into a pulp. With this method one must be sure that there are no cracks in the potato in the first place as the gold will run through, resulting in a frenzied search among the hot ashes for what should have been inside the "spud."

Where gold is obtained in reasonable quantities such as a mine, and it occurs in fine particles, a process called cyanidation is often used for recovery.

The ore is crushed and the gold brought to a concentrated state by a process of elimination of the coarser stone particles.

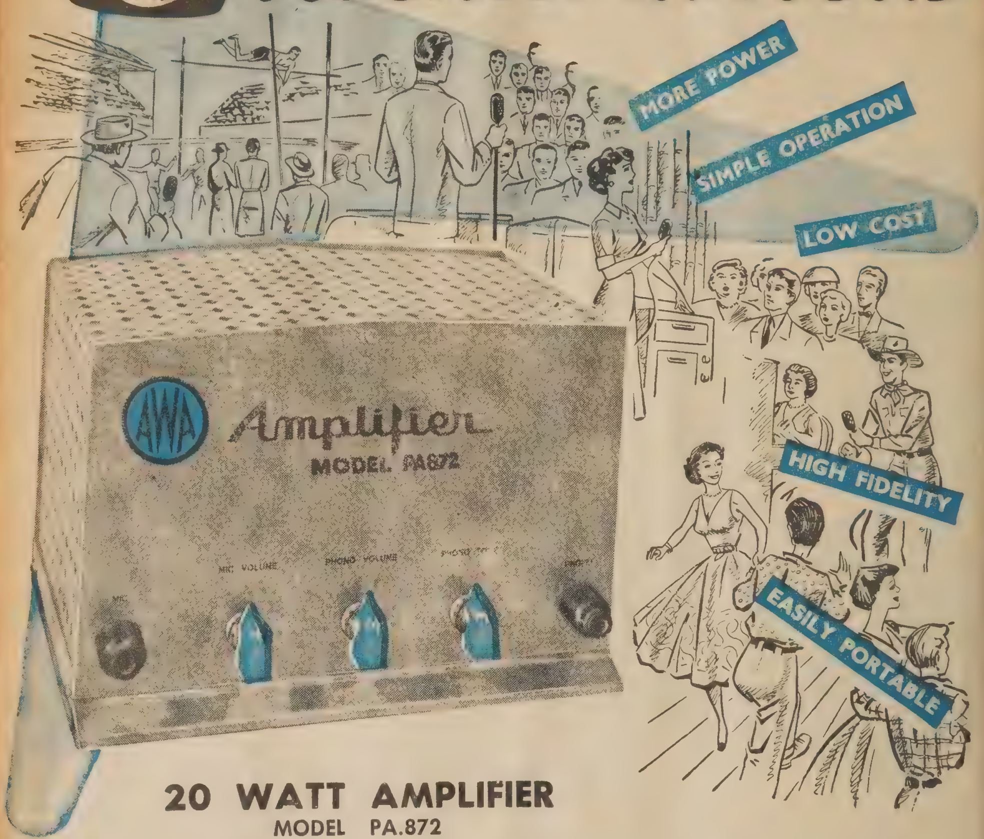
This concentrate is placed in specially constructed vats called leaching vats. The leaching solution is a solution of sodium cyanide.

Sodium cyanide absorbs the gold and the resulting solution is called a gold bearing solution.

This is run into an extraction box which is packed with zinc shavings. The zinc causes the gold to precipitate and collect on the zinc shavings.

After several washings the zinc shavings are dissolved in sulphuric acid and the gold sludge remains behind. The gold is recovered from this by either smelting in crucibles or by the amalgamation process described earlier.

AWA FOREMOST IN SOUND



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NEWS AND VIEWS OF THE MONTH

Ruins may pre-date Pyramids

IN the valley of the Indus River, in Pakistan, archaeologists are uncovering ruins of a high civilisation, with advanced techniques of writing and architecture, which flourished at least 5,000 years ago and may have preceded the Pyramid civilisation of Egypt.

Recent spectacular finds, according to the Educational, Scientific and Cultural Organisation of the United Nations, are filling in at least 700 years of hitherto lost world history.

The civilisation, called the Harappan, was concentrated in three large and rich cities—Mohengo Daro, Harappa and Kot Diji.

Present work is concentrated on Kot Diji, which appears to have been the oldest of the three.

Kot Diji consists of two distinct parts —a citadel area (500 by 350 feet) and a "suburbia," inhabited by an artisan class.

Most impressive feature is the citadel's defensive wall. Construction must have required an enormous labour force.

A thick deposit of charred materials spreads over the entire excavated area in the upper levels, indicating a violent conflagration which destroyed the settlement.

The excavations have yielded many pottery fragments of unique design. A baked figure of a bull resembles a representation of a bull found at Susa, in Iran, dating to 2700 B.C.

The inhabitants lived in dwellings of sun-dried brick on stone foundations. It is still unknown who they were or where they came from.

Pills for pilots

LITTLE pills of enormous explosive power are being produced at the U.S. Navy's ordnance proving grounds at Dahlgren (Virginia).

They are designed for automatic ejection of pilot, pilot's seat and parachute—a development made essential by the fantastic speeds of military planes.

Any spring-operated catapult is usually too slow to throw man and parachute clear of the tail of the plane at the speeds now achieved.

Now a pilot simply pulls down a curain in front of his face. This explodes he cartridge.

Instantly seat and pilot are thrown clear at a speed of about 60 feet a second, which is necessary to get over the ail safely.

Ejection from a safe altitude is simple nough, but the problem of ejection near he ground, where most accidents occur, eems also to have been solved.

National TV costs increase

NATIONAL television stations will cost taxpayers £2,410,000 in 1958-9 — an increase of £852,471 on 1957-8—according to the latest Budget.

The papers give these details:

- £420,000 extra to operate the existing stations in Sydney and Melbourne.
- £160,000 extra to expand the television services from the two existing national stations in those cities.
- £130,000 as preliminary expenditure to establish national television stations in the other four capitals.

National broadcasting stations will cost taxpayers £6,065,000 in 1958-59.

Big Atom Sub

THE U.S.S. Triton, largest nuclear submarine in the world, was scheduled to be launched at Groton, Connecticut, on August 19.

The first vessel to be powered by two complete nuclear reactors, the Triton will be more than half as long as an aircraft carrier.

It will be a third again as long as Nautilus, the world's first nuclear submarine, which recently made a spectacular journey beneath the North polar cap.

The 447-foot, 5,900-ton craft, built by General Dynamics Corporation, will be a floating, submersible radar statio with great range and speed.

It is designed to act as a radar ou post, stationed well ahead of the fleet.

It could also act as a radar installatio lying undetected off an enemy's coas tracking missiles or bombers leaving th mainland.

Captain Edward Beach, World War I submarine hero and former naval aid to President Eisenhower, will comman the Triton.

Captain Beach wrote the best-sellin books, "Submarine" and "Run Silent Run Deep," which was made into motion picture.

No cure for cold

MEDICAL Research Council doctor who have spent 12 years trying t track down the cause of the common cold are now convinced the quest is hopeless.

They believe the complaint can be caused by so many different germs i

DIAGNOSIS OF CARDIOGRAMS BY RADIO

CARDIAC victims may soon be able to travel in almost any part of the world and, at the same time, remain in the care of their own home town specialists. This has been made possible by a new system which will allow physicians to diagnose and recommend treatment for cardiac conditions by international radiophoto and radio program circuits.

The system was conceived by Dr Arthur Briskier of Mt. Sinai and French Hospitals in New York.

The new technique makes it possible for a physician in the United States to diagnose almost immediately the condition of a patient who might suffer a heart attack while travelling abroad.

During the tests, Dr Briskier transmitted the tape recorded sounds of a patient's heart beat from New York to Rome and Paris. Simultaneously, the patient's electrocardiograms were also transmitted by radiophoto to these points. In order to test the quality of the transmissions, the signals were rebroadcast from Rome and Paris back to New York.

Dr Briskier said the system will als provide the means whereby physician in all parts of the world can quickly have their cases evaluated by cardiac specialists located thousands of miles away.

Dr Arthur Briskier demonstrates reception of cardiograms.

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- ★ A MANUAL PLAYER

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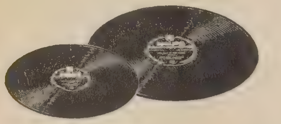
240 VOLTS, A.C. OPERATION, £25/18/-.



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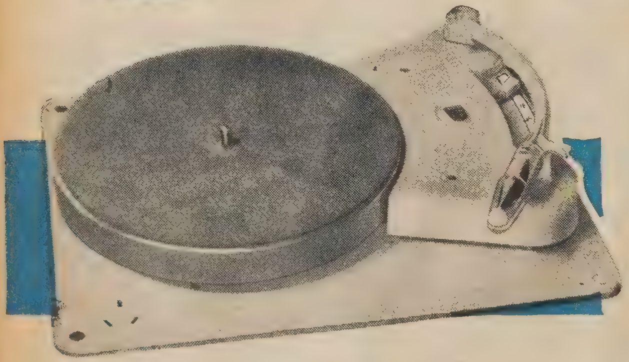

The famous Philips 4-speed recor player is available with mounting plat (as illustrated), which facilitates moun ing for radiogram conversions, built-i installations, portable applications, et Corner holes are suitable for grommet c spring mounting. Twin sapphire styl pickup head.

240 VOLTS, A.C. OPERATION £12/11/- (Mounting Plate 15/6 extr

PHILIPS

PHILIPS ELECTRICAL INDUSTRIES PTY. LIMITED

Sydney • Melbourne • Brisbane • Adelaide • Perth • Hobart ill be impossible to develop an effect- e vaccine against it.

Dr Christopher Andrewes, chief of the ommon Cold Research Unit, has told e Royal Society of Medicine in Lon- on he can list at least nine viruses cap- ble of causing cold symptoms.

These are probably responsible for nly a small proportion of the millions f colds which are the main cause of senteeism from work and school.

The Medical Research Council has ent about £400,000 on common cold search so far.

Professor Charles Stuart-Harris, of eeffield University, was the only doc- r at the meeting to offer any advice the treatment of colds.

"Whisky is the traditional friend of e cold sufferer," he said. "At least it akes him feel better."

terilised Rockets

OME scientists have advocated sterilising the United States moon cket scheduled for launching on Aug- t 15 or 16.

They want this done to prevent earth cteria reaching the moon and contam- ating it.

They want future scientists who will ake the space journey to find the moon actly as it is now and so avoid "scien- ic confusion."

A team of U.S. scientists is working ith British astronomers at Jodrell Bank, ngland, home of the world's largest dio-telescope, on the task of tracking e rocket.

The U.S. Air Force will aim the moon connaisance rocket in a bid to have nar gravity swing the rocket around hind the moon.

The plan is for the rocket to return earth in a giant figure eight.

The small loop of the eight would be ound the moon and the large loop ound the earth.

The plan is for it then to go into bit around the earth.

But the rocket could orbit around the on or hit the moon and contaminate with earth bacteria.

toms Fight Insects

IX British scientists have won the first atomic success against insect pests.

Their leader, Dr Henry Seligman, has nounced that grain weevils were suc- ssfully attacked with gamma-radiation m radioactive cobalt.

It cut down their life to a few days.

The scientists also sterilised certain ner insects by radiation.

The scientists carried out their tests at antage Radiation Laboratory, Berk- re.

In another scientific report, the British edical Research Council has released ails of strontium tests on rabbits.

It found heavy injections of strontium, ich is generated in nuclear explosions, oduced no blood or bone change in -days-old rabbits.

But older rabbits injected died some months later with multiple tumors d anaemia.

Different types of bone growth found different ages were suggested as the son for the tumor incidence in the er rabbits.

The scientists said they chose rabbits the tests because their bones were ilar to those of man.

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Record Changers: Collaro 4-speed changer **£18/17/6,** dual **£32/8/6,** Monarch **£20/10/,** Philips **£25/10/.**

Record Players: BSR **£13/15/,** Collaro **£12/10/.** Thorens latest model with G.E. VRIII head, **£35/15/.** Many others to choose from.

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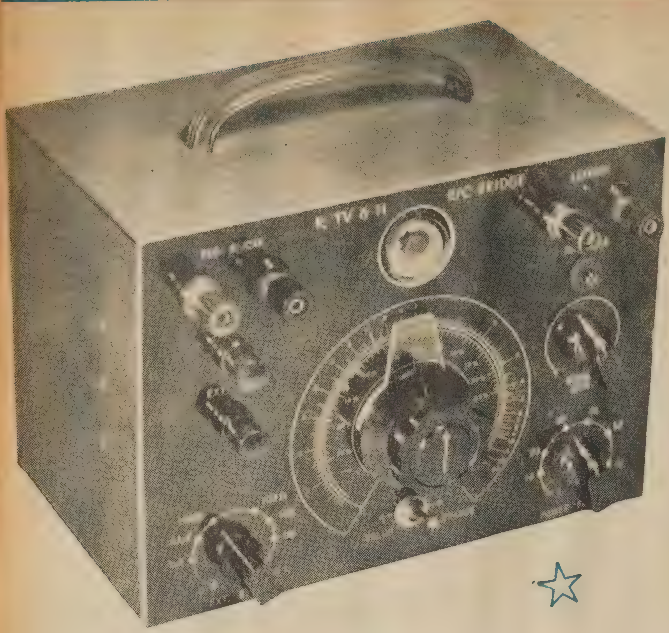
MAGNETIC SOUND INDUSTRIES

BISLEY HOUSE, 387 GEORGE ST. BX4440. BX4587



Here is our new resistance-capacitance bridge, complete with lettered panel and ready-calibrated dial scale.

Build This Resistance—Capacitance Bridge

For an outlay of a few pounds and a few hours work, you can have this excellent resistance-capacitance measurement bridge. Attractively finished, with an enamellised panel, it has the finish and accuracy of a commercial unit, costing a good deal more.

by Wes Yashin

IN the past, we have described several R/C bridges, which have proved quite popular, as evidenced by the demand for circuit reprints. Many experimenters and servicemen, however, have considered the instrument as a more or less luxury item.

REQUIREMENTS OF INSTRUMENT

With the advent of TV, the position has changed considerably. Because of the large number of wiring components used in a TV receiver, it is no longer profitable to replace suspect items on "spec" and a means for accurately establishing their condition becomes very desirable.

The proposition becomes even more attractive if the instrument for the job is simple and economical to construct and has an appearance to match that of any commercial unit likely to grace the work bench.

One difficulty with home-built test equipment has always been that of obtaining a professional finish due to the lack of neatly engraved panels and of accurately calibrated dials or scales.

On this occasion, we devoted a good deal of thought and effort to the problem, with the result that an attractively lettered panel, including the scale calibrations, will be made available.

The instrument is built into our standard small instrument case and will most likely be finished in a grey hammertone, which seems to be the accepted finish for commercial instruments, these days.

As originally described in the December 1954 issue, the bridge was quite functional and versatile. However, two additional features have now been added. These are (1) provision for tolerance checking principally against external standards and (2) an increase in gain, controllable from the front panel, to facilitate checking small or critical values.

SPECIFICATIONS OF INSTRUMENT

To allow us to introduce these features and retain a balanced appearance on the front panel, we had to delete an existing facility, namely the four-pin plug and socket arrangement which permitted the injection of a 1,000 cycle signal from an external source.

Aside from these new features the specifications for the bridge remain the same. The values of resistance which can be measured range from 3 ohms to approximately 30 megohms while the capacitance values range from 3pf to approximately 30 microfarads.

This range of capacitance and resistance is achieved in three steps for each, with adequate overlap, and covers practically all wiring components found in a radio or television receiver.

A single scale is provided for resistance and capacitance readings, the selector switch being arranged to interchange the reference standard and the "Res. and Cap." terminals in the bridge arm when going from one t the other.

Two external standar positions may also b selected by the switch.

A "power factor" or "loss factor," control is automatically brought into circuit and the .01 and 1 mfd ranges. Thi control permits the bridge to be balanced when measuring "lossy" capacitor and in so doing, gives the approxima power factor in percentage.

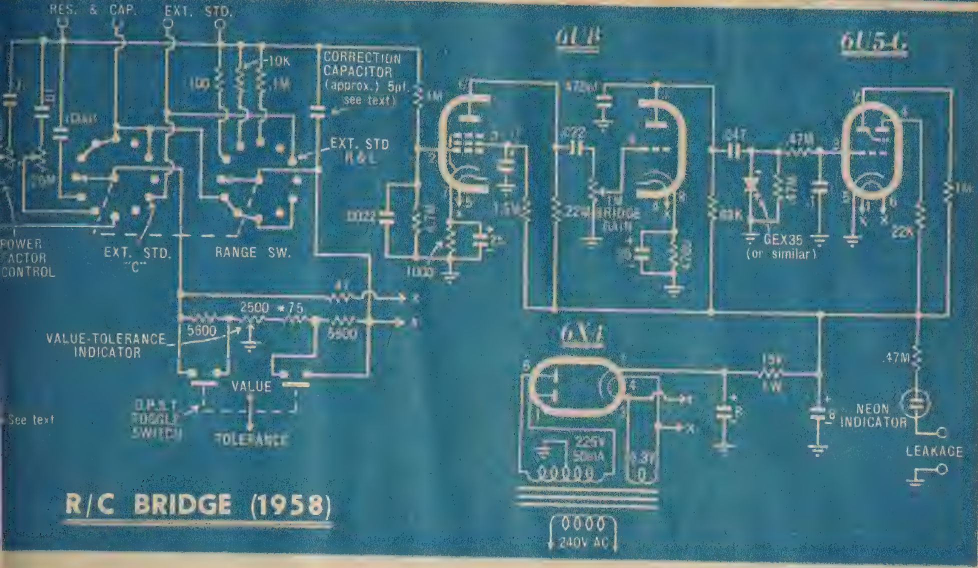
A leakage indicator is also provide on the front panel. When placed acro the relevant terminals, the capacit under test completes a series circuit wi a neon indicator across the HT supp voltage.

LEAKAGE TESTS

When the circuit is thus complete the charging current through the cap citor causes the neon indicator to igni As the charge approaches the HT vo age, the residual drop across the ne becomes too small to support the ionis tion, so that the indicator de-ionises.

This leaves the capacitor charged, t

CIRCUIT OF THE RESISTANCE — CAPACITANCE BRIDGE



circuit is along conventional lines but differs from the earlier version by the provision of variable gain control and a erance measuring scale. Resistors in series with the potentiometer allow it to be registered exactly to the scale if accurate checking facilities are available.

one connection virtually open-cir- d. The charge, therefore, tends to away through the capacitor's own al leakage, allowing the voltage on ndicator gradually to build up to- s another ignition flash.

capacitor with low leakage will a flash only at very infrequent in- s. One with higher leakage will ice more regular flashes, while a capacitor may cause the indicator ow continuously.

e flashing rate will vary with capa- of different value, while one's of what is a good or bad capaci- ill also be influenced by its place e circuit. A small amount of leak- ay be of no consequence in a by- but tragic in a grid coupling cir- t

CKING ELECTROLYTICS

e experience in using the device oon allow a capacitor's quality to sessed, particularly as prior warn- f leakage is often given by the to advance the power factor con- or complete balance.

ortunately, the job of checking lytic capacitors is not so easy and lom tackled seriously in a simple , commercial or otherwise.

difficulty about electrolytics is that apacitance and behaviour depends l deal on having a suitable polar- oltage applied during the test.

involves a means of varying and ng the voltage, supplying the y high re-forming current, and ing the standing leakage current. hout upsetting the basic action capacitance measuring circuit.

Short of such complications, a simple bridge cannot be expected to do more than indicate obviously low capacitance in units which have recently been removed from service.

In much the same way, inductors cannot be checked very effectively on a simple bridge. DC resistance has to be allowed for, while the indicated value of practical inductors is sensitive to the measuring frequency, and, in the case of iron-cored types, to the presence of direct current through the winding.

The provision of suitable measuring frequencies and variable DC with metering, is again outside the scope of a simple instrument.

The bridge can be used as a balance indicator between an unknown inductor and some external standard, but the results may not be very conclusive.

Examination of the circuit will reveal

PARTS LIST

1 Standard instrument case, 9⅛ x 6⅝ x 5½ inches with front panel to suit.
1 Chassis to suit.
1 Power transformer, 225/225 volt, 50 mA, 6.3 volts at 2A.
1 Noval socket.
1 7 pin miniature socket.
1 6 pin socket with cover.
1 2 x 12 switch.
1 DPST toggle switch.
1 Miniature neon, FP 70-volt type.
1 GEX35 diode (or similar).

VALVES.
1 6X4, 1 6U8, 1 6U5G.

CAPACITORS.
2 25 mfd 40 volt electrolytics.
2 8 mfd 350 volt electrolytics.
1 .1 mfd 200 volt paper.
1 .1 mfd 100 volt paper.
1 .05 mfd 400 volt paper.
1 .022 mfd 400 volt paper.
1 .0022 mfd 100 volt paper.
1 470 pf ceramic.

RESISTORS.
1 4.7 meg ½ watt.
1 1.5 meg ½ watt.
2 1 meg ½ watt.
3 .47 meg ½ watt.
1 .22 meg ½ watt.
1 .068 meg ½ watt.
1 .022 meg ½ watt.
1 .015 meg 1 watt.
1 1 meg potentiometer.
1 2500 ohm/.25 meg ganged potentiometer.
1 2500 ohm wirewound potentiometer (IRC or Naunton).

CLOSE TOLERANCE; HIGH STABILITY RESISTORS.
1 1 meg ½ watt.
1 .01 meg ½ watt.
2 5600 ohm ½ watt.
2 100 ohm ½ watt (one for use as external standard).
1 75 ohm ½ watt (see text).

CLOSE TOLERANCE CAPACITORS.
1 .1 mfd can type.
1 .01 mfd silvered mica.
1 100 pf silvered mica or ceramic.

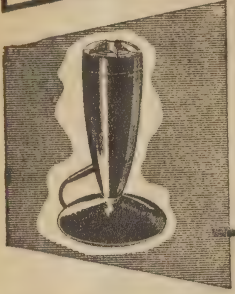
SUNDRIES.
4 pairs of terminals, 3 pointer knobs, 1 instrument knob and cursor, 1 8-lug strip, 1 7-lug strip, 1 4-lug strip, 1 3-lug strip, 1 2-lug strip, nuts and bolts, solder lugs, solder, tinned copper wire, hookup wire, grommets, shielded wire.

acos

A COMPLETE RANGE

CRYSTAL MICROPHONES
MICROPHONE INSERTS

FOR EVERY PURPOSE



DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6**

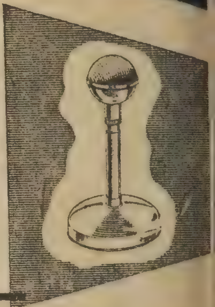
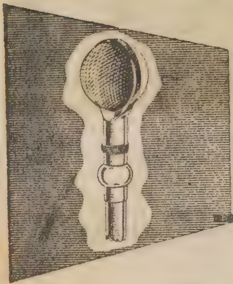


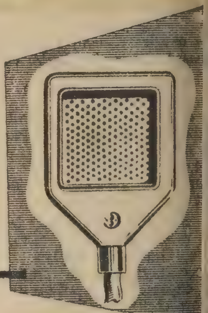
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost **PRICE. £9/18/6.**



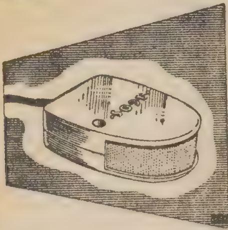
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



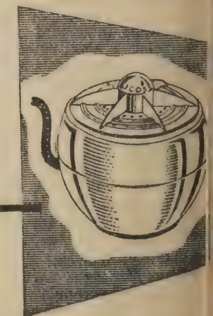
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel **PRICE, £5/19/6**



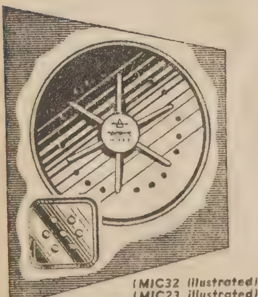
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



(MIC32 illustrated)
(MIC23 illustrated)

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as $\frac{11}{16}$ in. square to 1-$\frac{13}{16}$ in. round, with various thicknesses from $\frac{7}{32}$ in. to $\frac{5}{16}$ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

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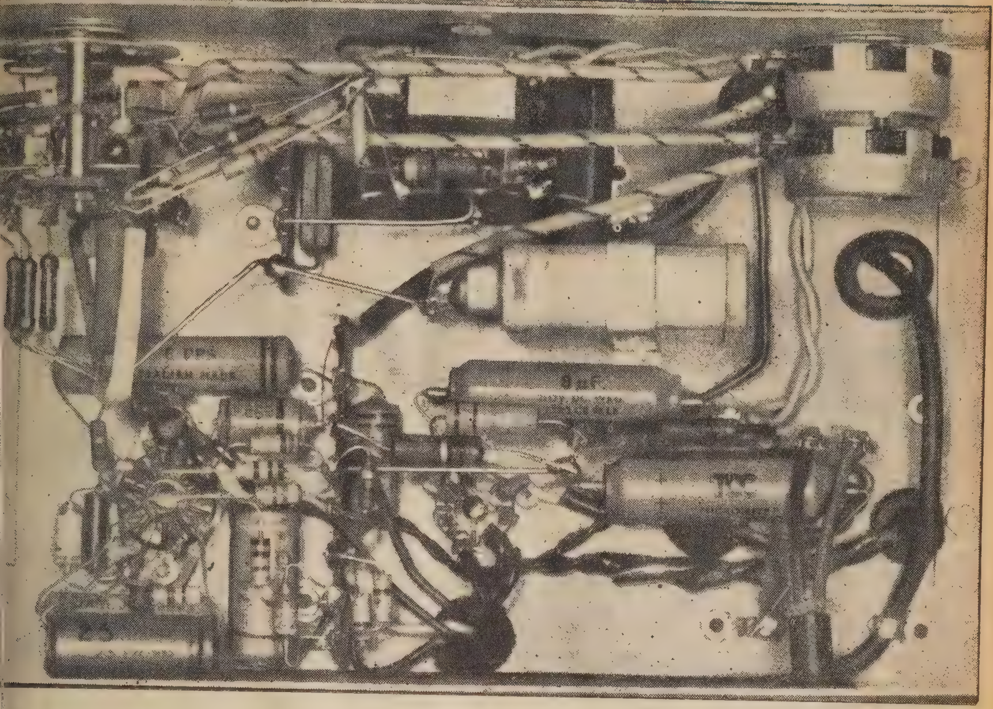
THIS UNDERNEATH VIEW SHOWS THE WIRING DETAILS



neat layout is apparent from this under chassis view. The selector switch is to the left, the tolerance switch in the centre h the ratio determining potentiometer directly below and the power factor control to the right. The standard components grouped around the selector switch, as is the bridge wiring. The amplifiers and associated components are grouped along the rear end of the chassis.

the bridge is of the familiar Wheat- type. This consists of four arms, resistive ratio arms, with the known lard in the third arm to be bal- d against an unknown in the fourth. r the purpose of discussion a basic it is reproduced. It can be seen the four arms form the sides of a e. The voltage source is fed across outer ends of the ratio arms while ndicating device is connected across emaining corners.

hen a condition of balance is ved, there is no potential applied he indicating device.

ould the unknown value equal the n, the balance or null point will chieved with the two ratio arms to one another.

IO RELATIONSHIP AND ANCE

a difference exists between the n and the unknown values, the arms will, at balance, assume the ratio relationship as exists between andard and the unknown.

our instrument, the ratio arms are d by the resistance between the g arm of a potentiometer and each f the element, while the balance tor is an amplifier and magic eye nation.

sensitivity of the indicator has a direct bearing on the sharpness of the null point and hence on the accuracy and ease of manipulation. Too much sensitivity renders the ratio control too critical to adjust. On the other hand, insufficient sensitivity, particularly on low values, gives too broad an indication, thus limiting the effective accuracy of the instrument.

In view of the foregoing, it is desirable to introduce some amplification of the signal before application to the indicator. We reasoned that the logical approach would be to introduce as much gain as was practicable, with some means of controlling this gain at will.

ELECTRICAL SPECIFICATIONS

Earlier versions of this bridge used single stage triodes or pentodes for this purpose, operating at maximum gain, but with no means of controlling the gain.

In this design we have substituted a two-stage amplifier, with gain control, using a 6U8.

The main difficulty with the operation of this valve at maximum gain is the feedback existing between the output plate and the input grid, since these are brought to adjacent pins.

To reduce this effect, it was necessary to bypass the input grid with a substantial value of capacitance. Since we are only interested in a signal of 50 c/s, the effect of this capacitor on the incoming signal is negligible. A 1 meg resistor is used to isolate the bridge circuit. A further precaution is a bypass from the plate of the triode section.

The gain control is brought out to the front panel.

CONVENTIONAL DIODE

Output from the triode section is fed to a conventional diode detector. Almost any type of germanuim diode will perform this function, the rectified signal appearing as a negative voltage across the .47 meg diode load resistor.

The rectified signal will carry some 50 cycle ripple and this is filtered by the .47 meg resistor and .1 mfd capacitor. Without this filter the screen of the magic eye would show a double shadow effect.

The eye itself operates in straightforward fashion. With the bridge unbalance, the signal diminishes, as also does to the diode, where it is rectified to a negative potential. Applied as a bias to the indicator grid, it reduces the shadow angle on the target.

As the bridge is brought towards balance the signal diminishes, as also does the bias on the indicator tube, with the result that the shadow angle increases to

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recording. A machine for the enth
ast. £165.

MAGNETIC SOUND INDUSTRIES (AUST.)

STREET LEVEL, Bisley House, 387 GEORGE ST. PHONE BX4440 or BX4587 maximum angle of 90 degrees.

The target anode, you will note, is l through a dropping resistor, to inase the life of the fluorescent screen hout much reducing the effective mination.

The power supply circuit is not unial. Output of standard transformer/tifier combination feeds into a resisce-capacitance filter. Due to the loss rent drain of the circuit, it is possible obtain adequate filtering using a high ue of resistance in place of a filter oke.

CCURACY OF STANDARDS

The bridge excitation source is taken m the 6.3 volt heater winding. A 50 n resistor in one leg limits the maxim current flow when low values of reance are to be checked.

The in-built resistance and capacitance ndards set the basic accuracy of the dge and it is obviously desirable to ain these to the lowest possible toler e. The resistors used in our instrunt were of the high stability carbon e having a tolerance of plus or minus er cent. You may or may not be able obtain capacitors to same degree of rance but these must be of the lowest rance practicable.

he 1 mfd capacitor should be a paper e, preferably can sealed and oil filled. were able to obtain this to a tolere of 2½ per cent.

may be worth remembering that acitors which are a trifle low in value be brought up to standard by coning small values in parallel with n.

he availability of dual-potentiometers oles two ranges to be covered with same calibration when checking the er factor of capacitors.

his control is calibrated on the asption that the standard capacitors a negligible loss factor. The control ates on the principle that the loss in pacitor may be represented by a rence in series with it and which can palanced by a variable resistance in s with the standard arm of the ge.

LIBRATION OF POWER CTOR

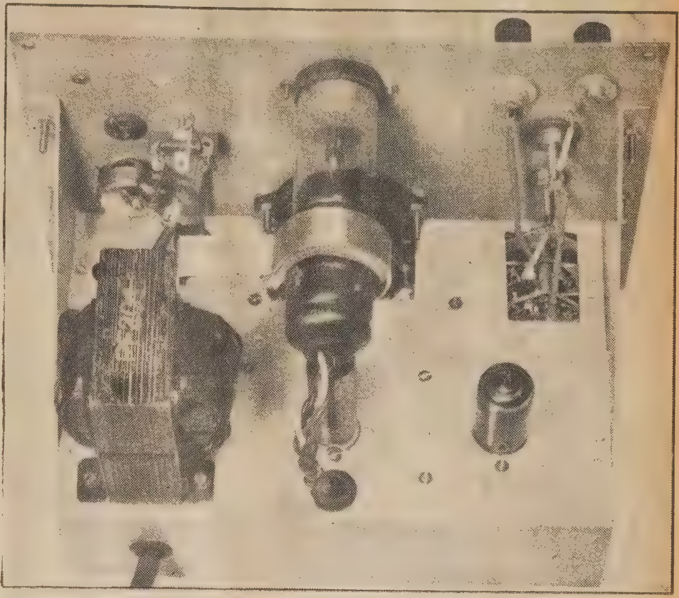
e basis of calibration for this conis the fact that the power factor, or factor, is the ratio of resistance npedance. For a given value of retice in series with the standard, the r factor of the unknown capacitor be calculated by dividing this resisn by square root of the sum of the e of this resistance and the square e resistance of the standard capaci- To obtain an answer in percentage, esult is multiplied by 100.

stating this formula to use symbols a simple matter, using the normal raic methods, to arrive at values of ance for various percentages of factor in steps of 10. The value tentiometers used will accommodate factors of up to 60 per cent.

practical use, the ratio control is ted to give a null indication on the nd, if necessary, the power factor ol is advanced to sharpen the null dition and to give a maximum w angle.

Wh a good capacitor, the power facntrol will not need to be advanced a Progressively higher degrees of ke will necessitate advancing the l more and more and this, together he leakage indicator, gives a clear ion of quality.

REAR VIEW OF BRIDGE CHASSIS

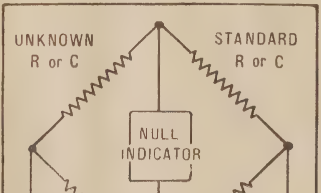


This view shows the simplicity of the major component layout. The 6U8 is near the rear right hand corner with the 6X4 directly below the magic eye indicator. Note that the leakage terminals are missing from the panel, as the bridge was in the process of checking when this photograph was taken.

Coming to the constructional side, there are points worthy of mention. The chassis and case are standard types and readily available through the normal channels. For those who wish to construct their own, a blueprint is available through our query service.

Mount the major components first then attach the chassis to the panel. When mounting the potentiometer and switches, pack them behind the panel and chassis so the securing nut is just full of thread. This will permit the knob to sit closer to the panel and present a neater appearance.

When mounting the terminals, see that they are well insulated from the panel. One of the leakage terminals is earthy, however, and it would be wise to make a direct connection from this terminal to chassis.



Here is the basic circuit of the bridge. In our case the signal is 50 cps from the heater winding, while the indicator is an amplifier-magic eye combination.

The power transformer is an upright type and the leads are brought through grommeted holes in the chassis. The sockets are oriented so that the gap between pins 1 and 7 of the 6X4 is toward the front panel while the gap between pins 1 and 9 of the 6U8 is toward the rear left hand corner of the chassis, looking over the rear edge.

An under chassis photograph is reproduced to facilitate the mounting, positioning and wiring of the various components. Mounting strips were used to support the minor components and preserve neatness. A seven lug strip to the right supports the incoming AC leads, the 6.3 volt leads and the limiting resistor to the bridge circuit as well as the filter capacitors and filter resistor in the high tension supply.

WIRING OF MINOR COMPONENTS

The eight lug strip between the two valve sockets supports most of the components in the voltage amplifier stages and the indicator valve circuit. Working from the rear edge to the front, the germanium diode and its load resistor are supported between lugs one and two, lug two being the earthy lug. The .47 meg diode filter swings between lugs one and and three, while the .1 mfd filter capacitor is supported between the latter and the remaining earth lug on the strip.

The dropping resistor to the target anode of the magic eye valve swings between lugs four and five, five being the B plus take off point for the various plate and screen resistors which swing

(Continued on Page 117)

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.0022/600	1/3
.0033/600	1/3
.0047/600	1/3
.01/200	1/3
.01/600	1/4
.022/600	1/6
.1/200	1/4
.1/400	1/9
.1/600	2/-
.22/200	2/-
.27/200	2/5
.27/400	2/6
.27/600	3/2
.47/200	2/8
.47/400	3/2
.47/600	4/2
.56/200	2/8
.56/600	4/9

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100 mfd/65v	7/6
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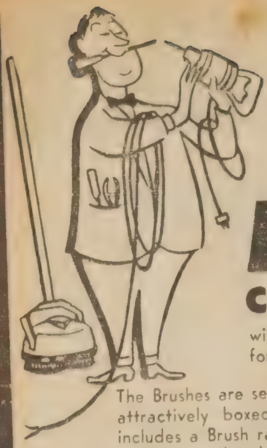

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FROM THE SERVICEMAN WHO TELLS

Getting away from TV for a change, this month's main story concerns a car radio, and the damage caused by a minor fault. Another kind of damage—to your serviceman—was nearly caused by another set as a result of something bordering on sabotage.

POINT of interest about the car set was the similarity between it and I wrote about some 12 months ago. ay, 1957, to be exact.)

n that occasion I described a set ch had a mysterious intermittent at" which would occur at odd inals for no apparent reason. No ount of prodding or probing would eal the fault, and I was finally ed to the conclusion that it had n due to a sliver of solder or strand wire, which had fallen out when pened the case.

hile I could never actually prove theory, it seemed to be born out he fact that the set performed pery satisfactorily thereafter. If it n't, I should certainly have known ut it—it belonged to a relative.

he latest set also had an intermit- "splat," as well as being of the make and model as the original. mittedly, the owner was not a rete, but was a friend rather than just stomer.

CONNECTION

the circumstances it is not surng that I mentally compared the cases, and I couldn't help wonderf there was any significance in the ar nature of the two faults. As it ened there wasn't—or not apparent—but the story is interesting enough own right.

really start at the beginning it cessary to go back several months, e time when the owner first mend the trouble to me.

y car radio has been playing up lately," he remarked. "It makes ny kind of spitting noise at odd als, as if something was shorting . Doesn't seem to affect its perance really, but I'll get you to have k at it sometime."

questioned him a little further on ubject and was beginning to build me kind of a mental picture as to verity of the effect when someone, of our wives if I remember corct, interrupted us and the discussion no further.

TI. THERE

en next I saw him a few weeks I raised the point again and he imed that it was still evident. However he was about to leave on holiand suggested that he leave it until urned.

afraid this was only the first step eries of procrastinations extending the next few months. For one or another we never seemed able together on the problem. When iend was not out of town, I was down with work. When I was he was busy; and so on. All we able to do was discuss the probn odd times and make vague prose about tackling it "sometime."

Of course, this could not continue indefinitely, and I was not really surprised when my friend appeared on the doorstep one night, a sheepish grin on his face and the set in his hand.

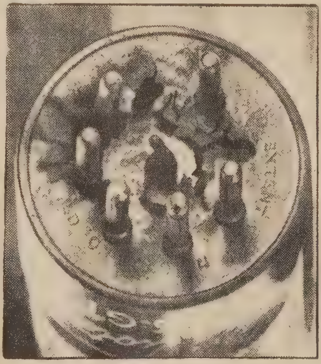
"Here," he said, "the thing's blown up at last. It won't go at all now, so there's no point in keeping it in the car. Tackle it whenever you have some free time."

I didn't take the "blown up" part of the explanation too seriously—and I don't imagine I was intended to but, as it turned out, the words were more prophetic than either of us realised.

POSSIBLE "SHORT"

However, when I eventually did get around to looking at it I thought it best to examine the set before switching on. After all, the trouble had sounded like a short of some kind and there is little point in risking damage to other components if the trouble can be located without applying power.

However, I was hardly prepared for what I found. One glance at 6X5 rectifier socket was all I needed to tell me where the trouble lay. It was a wafer type and the bakelite around pin 3 (one of the plates) was almost completely burnt away. Closer examination showed that the charred area extended in the direction of pin 2 (one of the heaters).



Obviously a flash-over in the base of this 6X5 was the cause of the severe burning as shown in this photograph.

It didn't require a Sherlock Holmes to deduce that there had been a flash-over between the plate and heater pins, but there still remained the job of finding out why. It could have been simply a faulty socket, but I was more inclined to suspect a defect which allowed higher than normal voltages to be developed, such as a defective buffer capacitor.

I reached around the other side of the chassis and began to withdraw the 6X5. As I did so I realised that, although the valve was moving, the spigot was quite stationary. The full significance of this did not strike me until I actually withdrew the valve.

Only then did I realise just how extensive the flash-over must have been. The bottom of the valve base was almost completely burnt away, affecting not only the spigot, but most of the valve pins as well. These were simply hanging by the lead wires and had been held in place mainly by the socket. Altogether, it was a rather unsightly mess.

(Subsequent tests suggest that the 6X5 is quite all right internally. Although of no further use professionally, I propose to fit it with another base, probably salvaged from a defunct valve, and add it to my personal junk box. I can think of plenty of uses for it.)

AWKWARD JOB

I turned my attention to the socket again, and considered how best to get it out. It would have been easy enough to break it up and extract the separate pieces, but this was something I did not want to do, preferring to get it out in one piece so that it could be photographed for inclusion in this article.

This was not especially easy. As always, the leads to each lug had been twisted around and through it about three times, making it a work of art to remove a wire without breaking or cutting it. (Some set manufacturers have a fiendish sense of humour.) This, coupled with the restricted space, made the job quite a ticklish one.

Nevertheless, I made reasonable progress with the heater and cathode lugs and was about to start on one of the plate lugs when I made another discovery. Of the two connections to this lug—the transformer lead and the buffer capacitor—the buffer connection was one of the most beautiful dry joints I have ever seen.

DRY JOINT

Visually it was perfect. It was not until I actually applied pressure to the buffer that I realised that the two lugs were making contact only by reason of the pressure between them. The buffer was a large mica capacitor, fitted with flat lugs rather than pigtails, and was mounted directly between pins 3 and 5 of the socket. It was securely anchored to pin 5 and had a natural pressure against pin 3, the site of the dry joint.

This, of course, was the prime cause of all the bother. A vibrator circuit deprived of a buffer can generate extremely high peak voltages; quite high enough to flash across the pins of a valve or socket. In all probability, the buffer was functioning most of the time, only losing contact occasionally, as under conditions of road vibration.

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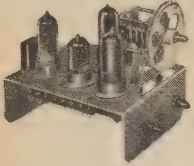

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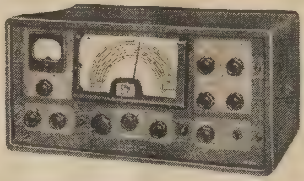

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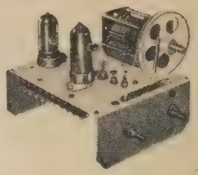

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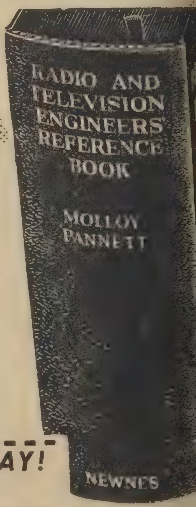

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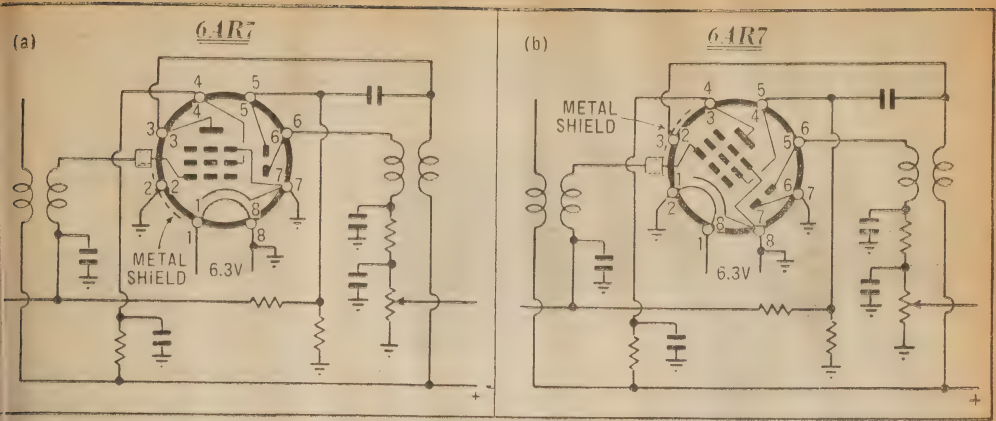


orcing the valve into its socket with the pins displaced by one in the order of rotation had this surprising effect on the circuit.

a flash-over, and each flash-over uld burn the socket a little more. entually a carbon track would be ilt up to the point where current uld flow even at normal voltages. om this would come more carbon, n more current, then more carbon il the disintegration was complete.

Well, at least there was no mystery out it any longer.

The next step was the essentially ctical one of replacing the socket, even this was not to be all plain sing.

he socket was a wafer type, but n one of the regular variety readily ilable as replacements. It was a good d smaller, particularly as regards the cing of the mounting holes, and was bably one of the maker's own products.

here was no room to fit a regular wer type in place of it, nor was there icient depth, after allowing for other ponents, to fit a moulded "single-he-mounting" type. It looked as though ould have to wait until I could ob- a a replacement from the makers; a trating procedure which I didn't icularly relish for a job of this kind

he second complication was the fact the socket was riveted to the chassis tubular rivets. While easy enough andle in the ordinary way, I didn't y the task of trying to bash these place in a completed chassis, particu rly as the area around the socket far from accessible.

ELACING RIVETS

or was it easy to replace the rivets nuts and bolts. The mounting holes too small to take ordinary 1/8in and too close to the main socket to bear enlarging. Again, because he small spacing between them, d head screws could not be used, they would foul the underside of alve base. On the other hand, there not enough material to allow much tersinking, certainly not enough for ndard screw.

loking at the socket again I seemed ecognise something familiar about en though it was not standard Somewhere I had seen that type e, and not only in car radios. Then embered—disposals. Yes, there had a lot like that in disposals gear and, with a little luck, they might fit or be made to fit.

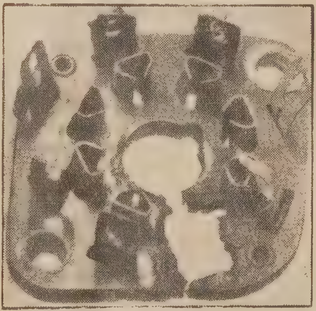
All I had to do was find one.

There followed a hunt through a heap of disposals gear, most of which seemed to have every type of socket except the one I wanted. However, I did find some, and most were in first-class condition. What was more important, they were an exact replacement for the damaged one.

SMALL SCREWS

I overcame the mounting problem by locating some very small countersunk screws—one of the "BA" sizes—in another piece of disposals gear. By countersinking the chassis holes as much as I dared, these fitted almost flush with the surface.

With a new 6X5 fitted the set worked immediately, and seemed little the worse



This picture gives an excellent idea of the extensive damage caused to the socket by the flash-over. Before lifting it from the chassis the hole was a mass of charred bakelite.

for its experience. I was mainly concerned about the vibrator, since operation without a buffer can ruin these devices very quickly, due to the severe arcing brought on by the high voltage peaks.

However, in terms of HT voltage and general performance it seemed quite O.K., so I could see no point in changing it. After a routine check I passed it back to the owner, he having been rash enough to offer to fit it back in the car himself.

I didn't argue with him on that point.

My next story is something of a twist on what was, at one time, a very common source of unnecessary service calls. Those of my readers old enough to remember the autodyne era will probably also recall the strife into which non-technical owners could get themselves by transposing valve positions.

The popular "57-58-57" combination (or "6C6-6D6-6C6" in later years) which performed the task of autodyne mixer-oscillator, IF amplifier, and second detector respectively, were the ones usually involved.

SAME SOCKET TYPES

Not only did the two types use the same socket, they were virtually identical in appearance. Thus the unsuspecting owner who removed them generally imagined that all three were the same and pushed them back in the sockets in random order. It was one chance in three that the 58 would find its way back into the IF socket; more usually it finished up in the autodyne or second detector sockets.

It would not always work in the autodyne position, while the combination of a 57 in the IF socket and a 58 in the second detector produced some weird results, particularly in strong signal strength areas.

The usual reason for removing the valves was a belief that they were faulty and needed testing. A classic case I remember was caused initially by someone accidentaly tripping the "local-distance" switch into the "local" position, thus effectively blotting out all but the one local station. (The owner hadn't a clue what the switch was for, anyway.)

Peering into the back of the set he was unable to observe the filament in the three valves concerned (most of the glass was covered with getter in those days) and so assumed they were faulty. He hauled them out, brought them to me for testing, and seemed to doubt my word when I assured him they were OK.

He seemed hesitant to incur the expense of a service call, and simply took the valves back and plugged them in again. When the set refused to operate

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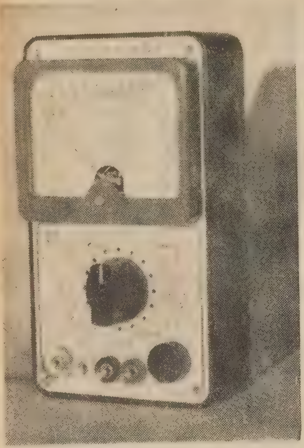

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all he was sure he was being "got Either I didn't know my job and valves were faulty or I had delib- ely damaged them to make a job myself.

Vhen I was finally allowed to look the set it took me less than five utes to re-arrange the valves and over the wrongly set "local-distance" ch: five minutes which, I'm afraid, cost him a service call.

omething similar must have happen- in the case I am about to relate, igh I'm afraid the full story will er be known. The set was a five e mantel set using the later octal s, viz., X61M, 6AR7, 6AU6, 6V6, 5Y3. As one would expect, it was nally capable of a very good perfor- ce.

he owner complained that the sig- were very weak and a preliminary k in the home confirmed this. As I made an attempt to discover thing of the history of the set and fault, but the owner was rather ly and inclined to be vague about I didn't press the point.

quick routine check revealed noth- obvious. All the heaters were alight, were no loose grid leads, the l was connected—such as it was— there were no controls which might confused the owner. It was clearly b for the workbench.

ck at the shop I slipped it out e cabinet, plugged it in, and gave top of the chassis another visual ction. Then I commenced to turn er for a check of the underside. e next moment I felt as though ld been hit in the chest with a hammer. Somehow I had brought hand in contact with something while the other was holding the is. As a result I really "copped ight across the chest, and I can you it wasn't pleasant.

chassis lay partly inverted on the where I had managed to rid my- f it in the moment of stress. Pull- t the power plug I turned it right p and tried to remember where and had been, and work out what possibly be alive.

C SHIELD

A far as I could see I had been g one of the IF transformers, with AR7 close alongside it. Switching t on again I picked up a screw- and shorted the metal shield on tside of this valve to the chassis. reenough, there was a resounding ' and the tip of the screwdriver d to bite a hole in the surface chassis.

Wl, at least I knew where it was, f not exactly why. Still exercising e caution I turned the chassis and studied the socket of the ng valve. It didn't take me long lise what had happened, though ess it staggered me somewhat.

e bright individual had removed lve for some reason and, in re- it, had completely ignored the e of the key and keyway, simply it into the socket by sheer brute Being a wafer socket the punch- elite had cracked under the strain, g the valve to be pushed home.

a colleague remarked, "Some shouldn't be allowed to handle g more delicate than a crow- a ten pound hammer."

there was another surprise in e. The valve had been rotated by one pin only, and this had brought about a number of interesting situations.

First — and most important — it had moved valve pin 2, the external shield, to socket pin 3, the plate. It was the 250 volts intended for this latter element that had appeared on the shield; to my extreme discomfort.

CIRCUIT SURPRISES

Even more surprising was the effect on the heater circuit. Pins 1 and 8 are the heater in this valve, and it so happened that (normally) pin 1 was connected to the active side and pin 8 to the earthed side of the heater supply. When the valve was rotated, pin 8 was connected to the active side, while pin 1 was earthed via socket pin 2 originally used to earth the external shield. Thus the heater was still energised.

In fact, checking each pin in turn, I encountered a surprising number of such coincidences. So much so that the valve almost, but not quite, continued to work in the new position. The cathode was originally earthed via pin 7, but was still earthed when it moved to pin 8. Pin 6 was the diode detector circuit and, although this diode was now moved to pin 7, it was replaced by the diode on pin 5.

The only snag was the plate and screen circuits. The plate circuit (i.e., the IF transformer winding) was connected to the external shield, while the plate proper was now connected to the screen circuit. Much as I would like to, I'm afraid I can't make a case for the valve working under those conditions.

It would seem that the small amount of signal which did reach the output was the result of random coupling and operating conditions which allowed some transfer and some detection to take place.

As for how and why the valve came to be rotated, I'm afraid that must remain a mystery. The set functioned perfectly immediately I replaced the valve correctly and no amount of checking revealed anything else at fault.

I replaced the socket (I had no desire to allow anyone else to collect the same "wallop" that I had), gave the set a routine check, and returned it to the owner.

He was as mystified as I was, and could offer no explanation. I can only surmise that the offspring of some visiting relative might know more about the problem than he cares to tell, unless he was forced, that is.

And brother, would I like to do the forcing.

CINERAMA

While chasing up the reference (May 1957) which I quoted at the beginning of this article, I came across my April 1957 article. I was reminded that, at that time, I was having my own little argument with an anonymous member of the medical profession; the subject being Cinerama and its relation to true 3D systems.

Quite apart from the gist of the argument, I ventured to suggest, regretfully, that we were unlikely to see Cinerama in Australia. Just to show how the words of a prophet can be turned against him, it is now announced that this optical masterpiece is due for demonstration in Sydney in a few weeks time. I must make a point of seeing it.

I hope your offer still holds, Doctor; that is, assuming I don't find it "terrific."

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Here's your answer, Tom!

Tom's queries this month deal with subjects which have been covered in past issues on more than one occasion. However, they are typical problems which bother most beginners and there must be a good number of these regularly stepping into the ranks of our readers.

IN thinking about elementary questions, it may be wrong to consider only beginners. There may be plenty of "old hands" who have come to accept as fact some point which they really do not understand. We trust that the answers set out below will assist such readers also to glean extra knowledge and a better understanding of this fascinating hobby.

* * *

How are the electrodes arranged in a Beam Power Tetrode?

Here is a case, Tom, where one illustration is worth pages of written material, hence the reproduced drawing of the structure of a beam power valve.

Perhaps we should begin by pointing out that beam power valves were developed for much the same class of work as pentode power valves. In fact, they operate very much like pentodes, except that function of suppressing secondary emission of the plate, instead of being performed by a suppressor grid, as in a pentode, is performed by the electron stream itself.

The beam-forming plates have an important part to play in this function. Being connected internally to the cathode, they force the electrons to flow in two dense streams, through the grid and screen, toward the plate. The electrodes are so designed and placed that the electrons slow down to comparatively low velocity in the region between screen and plate.

They therefore strike the plate at low velocity and, if secondary electrons are emitted, they are largely prevented from reaching the screen by the dense cloud of slow-moving electrons in between.

* * *

Is a constant frequency oscillator converter a good idea? Reference to this circuit was made in your October 1939 issue.

Having looked up the circuit to which you refer we can only say the idea appears to be in order. However, we have not tried it nor have we seen it put to use since it was printed. We can only assume that disadvantages in its practical application outweighed its theoretical advantages.

* * *

Provided the peak voltage rating is not exceeded, what are the effects of ripple amplitude and frequency on a capacitor?

Obviously your query is directed at filter capacitors which are normally of the electrolytic type. The working voltage rating of these capacitors is the sum of the DC voltage plus the peak AC ripple voltage superimposed on it.

Actually the ripple voltage must not exceed a small percentage of the peak working voltage, a common figure being six per cent at 100 c/s and twice that at 50 c/s. Electrolytics will operate satisfactorily with this order ripple voltage superimposed.

The amount of ripple to which a capacitor is subjected is determined by its position in the circuit, the impedance of the circuit and the amount of capacitance.

Obviously, the first electrolytic in a filter system is likely to be subject a greater ripple than others. In a h impedance circuit, ripple will be l than in one of lower impedance, cause it cannot charge or discharge capacitor as easily. Again, in a gi position, a large capacitor will be s ject to less ripple than a smaller c because it can exert a greater stor effect.

Such things can be calculated, T if your maths is strong enough, or be measured with suitable instrume Otherwise you have to rely on est lished circuit designs or on data, wh capacitor manufacturers occasion release, showing permissible values capacitor in typical circuit arrangeme

And what is the effect of rip Well, excessive ripple will cause a t perature rise and prejudice the life performance of the capacitor. Perh a good many of the electrolytics w have "died" prematurely and mys ously during the history of radio h been victims, not of voltage surge of chemical failure, but plain, ordi ripple.

* * *

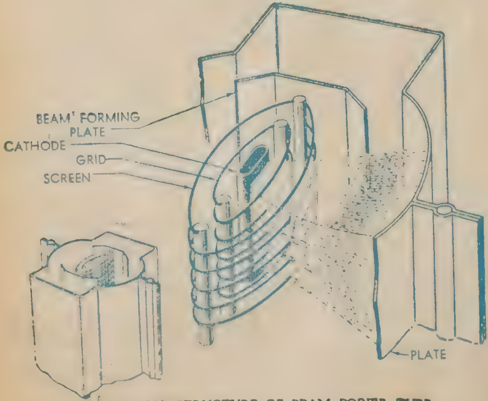
In the constructional article in first part of a 4-valve receiv in your June 1958 issue, you stat that a bulky and expensive filt choke was replaced by a network capacitors and resistors. I have e closed part of a circuit using filter choke and would apprecia it if you could suggest suita values of resistance and capacity place of the choke.

The circuit enclosed by Tom a conventional power supply and put stage which appears to be oper at maximum current drain. The fier used is a directly heated typ while the filter system consists of and a 16 mfd electrolytic with mA choke interposed between ther

The technique of resistance-ca tance filtering has largely been possible by the release of high citance electrolytics. Whereas "ele were once limited to 8 or 16 mfd, ern types can be purchased in up to and beyond 100mfd.

It is noteworthy, however, that capacitors are available mainly moderate voltage ratings. They therefore applicable only where sive peak voltages are not involve preferably with indirectly rather directly heated rectifiers.

Another point is that the eff of a resistance-capacitance filter is poor where high current drain volved. A heavy current will



INTERNAL STRUCTURE OF BEAM POWER TUBE

The electrode structure of a typical beam-power valve, showing how the secondary emission is suppressed.

lrain the energy stored in even large apacitors, between input peaks from the ectifier, causing a marked ripple content to appear on the HT supply.

Furthermore, if high current is passed hrough a dropping resistor, it causes onsiderable voltage loss, which may be erious in itself as well as representing lot of heat energy which has to be lissipated by the resistor.

In the case of a push-pull ampli- ier, it is often possible to tolerate a air amount of ripple in the HT supply o the output valve plates, by reason f the fact that the hum component fed n-phase to the two plates cancels as ar as the speaker is concerned.

The screens and the remaining stages an be fed from the rest of the filter etwork consisting of a resistor and cap- citor. Since the combined current drain ill not be very high, a fairly large alue of resistance may be employed, ne overall filtering action being quite ffective.

Any high gain preamplifier stages will equire a further resistance capacity net- ork for decoupling purposes and as dditional filtering.

The method of filtering discussed is ot restricted to push-pull amplifiers. It ay also be effectively employed in ngle-ended amplifiers and small re- ivers, provided the total current drain not high.

LTERING

In such instances, the plate supply the output valve, the chief source current drain, is connected to the st electrolytic, which is made as large is permissible with the type of recti- r used.

Complete filtering is not achieved but usually adequate, since no amplifica- n takes place after the plate of the tput valve. Moreover, small receivers generally equipped with comparative- inefficient speakers and baffles, so at the hum frequency is further attenu- d.

The screen supply, however, requires re efficient filtering since amplification tween screen and plate does exist. Con- quently the screen as well as the re- ining stages are supplied from the t of the filter consisting of a resistor d capacitor. Because of the low current ain, the value of this resistor may be de quite high and the filtering action the network will be adequate.

Last but not least, Tom, you will ice that many receivers and amplifi- using resistance-capacitance filtering, employ negative feedback from the put transformer secondary to an lier point in the amplifier. Apart m improving amplifier characteris- , it also helps reduce any residual n not eliminated by the filtering.

OT ADVISED

his is the general background to the ole subject. In your particular case, would not suggest trying to use re- ance-capacitance filtering. You do not w the HT secondary voltage of the nsformer but presumably it has been nged to give proper plate and screen s with a choke in circuit. To sub- tute a resistor could upset this.

nother point is that your feedback es from the actual plate circuit and residual hum in the plate supply would be coupled by the feedback to a preceding point in the circuit and possibly amplified.

Add to this the cost of new and larger electrolytics, plus the filter resistor, and the scheme would not be worthwhile. After all small filter chokes aren't very expensive.

★ ★ ★

Why is there a lot of noise or hiss in a receiver when tuned to a weak carrier and little or no noise with no carrier?

The answer to your question, Tom, involves a discussion on signal-to-noise ratio. Every receiver has a certain amount of inherent noise, due to random electron movement in the valves and tuning circuits. The higher the gain of the receiver, that is the more sensitive it is, the more apparent is the noise. This phenomenon would account for the initial noise level with no incoming carrier.

As a very weak station is tuned in, the hiss becomes more obvious because high frequency components in the receiver heterodyne or beat with the incoming signal to produce extra audible noise. The hiss is obviously at its worst when the receiver gain is near maximum.

As a strong carrier is tuned in, the A.V.C. comes into effect and reduces gain of the receiver's early stages to prevent them from being overloaded. Reducing the gain diminishes the noise level, while using a good aerial improves the signal-to-noise ratio and often causes the noise level to be reduced to such a level that it becomes almost inaudible in the presence of a strong signal.

★ ★ ★

What effect has the plate load on the performance of a valve and has it any connection with the following grid leak?

Both the components you mention, Tom, form part of a network referred to as resistance-capacity coupling. The purpose of this network is to couple succeeding stages one to the other.

An alternating voltage is developed across the plate load resistor due to the alternating plate current of the valve which flows through this resistor. The second component in the network, namely the capacitor, allows this alternating voltage to be fed to the grid of the next stage without upsetting the grid bias of that stage, due to the DC component which is also present.

The grid leak is there to maintain the correct bias condition without disturbing the alternating voltage and is therefore connected between the grid and some other point which determines the bias voltage.

COMPONENT VALUES

The value of each component in the network has a bearing on the others and on the operation of the amplifier.

Consider the plate resistor first. Its value affects the gain of that stage, as well as the frequency response and the maximum output it can deliver. The distortion content at maximum output will also be decided largely by the value of this resistor.

A very high value will give most gain but the frequency response will suffer. This is due to stray capacity which is always in parallel with the load re-

(Continued on Page 121)

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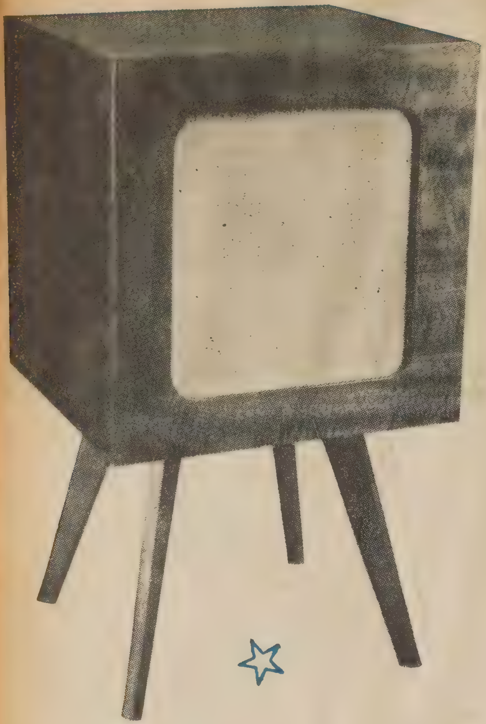
A Simple Speaker Baffle

An effective, simply made loud speaker enclosure which has proved very popular with our readers, and which should be ideal as a mounting method for two stereo speakers of moderate cost.



Our cabinet was simply glued and screwed together, sanded, stained, and given a coat of clear lacquer. Expanded aluminium covers the speaker aperture.

IN the issues of May and June, 1957, we described a complete radiogram housed in a cabinet for which constructional details were given. This project obviously interested a large number of readers, not only because of the very good chassis it included, but because of the unusual type of speaker enclosure featured as part of the cabinet.

Judging from our mail bag, many people made up the enclosure as a separate unit, and have been exceptionally pleased with it.

We have also experimented on similar lines, making up a second version so that we could compare directly the behaviour of various speakers and also to observe whether any other arrangement of baffle sheets would improve its performance.

PROMISING SOLUTION

The net result was to confirm our original opinion that here is one of the simplest and best methods of housing the more modest 12in speakers, and one which, with appropriate allowances, compares quite favourably with much larger structures.

It has been our intention for some time to republish these details, but we are inspired to do so now because of the great interest there will soon be shown in using two speakers for stereo work. Many people can manage to house one fairly large enclosure in a room, but two become not only awkward to place but also very expensive to buy.

Now stereo loses much of its appeal if it is confined to the hi-fi market, and rightly so because it is not essentially a hi-fi concept at all. It brings new dimensions to sound which are valuable even when applied to comparatively simple equipment.

That was the thinking behind our early description of a simple 2-channel amplifier in the July issue. Used with a crystal type pick-up it gives really impressive results in the ordinary home, and it is quite certain that large numbers of music lovers will use something similar in the near future.

But the speaker position still requires some careful thought, because it is the key to the end result.

And so we turned to this small, compact enclosure as holding the possible answer.

THE VERY BEST

There is no question that, for really high-class results—well beyond the usual commercial standards—only large speakers with 12 or 15 inch cones, big magnet structures, and low resonances, and mounted in large horns or enclosures, will do. Nothing we shall say about this speaker system should be taken to imply otherwise.

But as few people can afford to buy or to house two speakers on this scale, they must use something which will approximate the best as nearly as possible and be happy with it.

The design of this enclosure visualises the smallest practicable cabinet which will house a 12in speaker, and becaus our bass response, which is the real concern of all enclosures will depend largely on the radiation from the cone, it is bes not to use a smaller size.

This sets the cabinet dimensions at about 18in square wit the speaker itself mounted to the front face on a baffle board

If the cabinet is left as a hollow cube, it acts as a reasonable baffle, but exhibits a strong resonance which is quit intolerable, particularly on voices.

In the past many suggestions have been made to fill u or treat the cabinet to kill these resonances, and one of th most promising of these was originated by Hartley who calle it a Boffle. He used a very low resonance speaker, and fill the cabinet with a number of heavy felt partitions, each w a centre hole of different diameter so that the cabinet w broken up into a large number of acoustically deaden chambers. He ended up with a back piece in which there w no hole.

KILLING RESONANCE

Thus he dealt with cabinet resonance without using totally enclosed box. This would have raised the speak resonance quite sharply because of its small cubic capacity.

Our idea went along somewhat similar lines, but the fi result is rather different. We liked the idea of dividing cavity into many smaller sections, but we used cane fibre bo of which several varieties are easily obtainable. Heavy is costly and hard to get.

The use of centre holes of different diameters is a fundamental, for even when well damped, it would be d practice to introduce cavities which could resonate at the sa frequency.

These dividing sections, or partitions, or whatever care to call them, were then stacked into the cavity, separa by wooden frames which we made up from scrap mate The only purpose of the frames is to act as spacers.

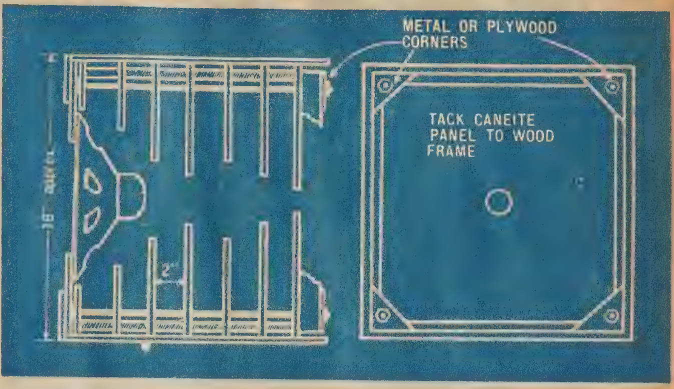
We held the assembly rigid by running four rods thro the partitions and spacers near the four corners, and bolting the whole thing together with the aid of triangular bracing pieces cut from old radio chassis. The assembly, which is shown in the photograph, was then slid into the cavity where it was a tight fit, and lightly wedged in place to avoid rattles.

The fibre board is much more rigid han felt would have been, and we herefore provided a vent hole at the back which released air pressure and which, at low frequencies, radiates an appreciable amount of power.

The net result was an acoustically dead cabinet in which the previously noted resonance was almost entirely absent, which imposed a fairly flat load on the speaker cone over the range of ow frequencies, and which provided ubstantial radiation from the back.

Now to control the design of such cabinet would be extremely difficult f not impossible by calculation, and would involve a long series of experiments and measurements to fully anayse. Fortunately, observed results do ot indicate that such a process is essenal, although it would comprise a very nteresting field for the experimentally minded enthusiast with plenty of time nd equipment.

DETAILS OF ENCLOSURE PANELS



This diagram shows our original layout for the partitions. A layer of cloth between the baffle board and the aluminium will help avoid rattles at this point.

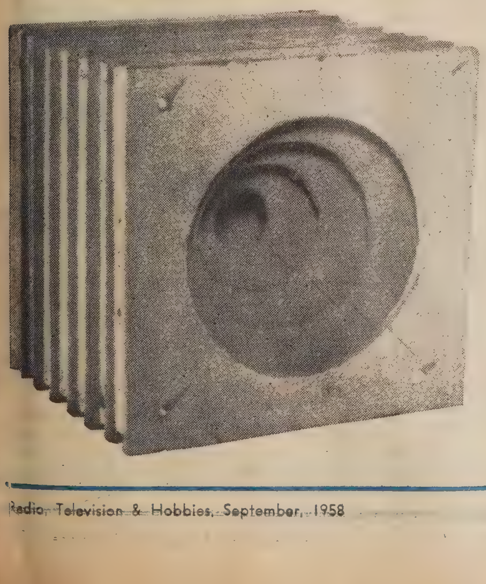
Reports from readers indicate that the order in which he graded centre holes are arranged has some bearing on reults, and also the diameter of the last hole.

Our own tests indicate that there is not a great deal of ifference to be heard by changing the partitions around. Our rst effort broke them up as per the diagram, and in similar rder to that used by Hartley, who was obviously trying to void any insertion of a regular pattern which might encourge repeat resonances. It is more likely that results will vary omewhat from speaker to speaker, and most certainly with oom positioning, to such a degree as to make it impossible recommend one order rather than another.

IZE OF VENT

Similarly we found that, as long as the hole diameter in he rear partition was approximately 2in diameter, all was ell, although the size of this hole might be well worth exerimenting with if you are so inclined.

It is pretty clear, however, that the device is not in way a vented enclosure, for it has none of the essential n features of such an enclosure. It should rather be condered as a form of infinite baffle, with a controlled release ent to avoid too great a rise in speaker resonance. Apart om this, much of its efficiency rests on its near-complete vity damping and essentially irregular partition dimensions.



A photograph showing the assembly of the baffle partitions. This should slide into the cabinet with as firm a fit as practicable. Keep the box measurements accurate to ensure this.

This is the reason why its construction does not appear to be particularly critical.

Tested with the input from an oscillator, there is naturally a drop in efficiency as the frequency is lowered, for this is the pattern of the speakers. What is valuable, however, is the comparatively smooth roll-off which is achieved in the bass end, and the amazing amount of near-fundamental output which is obtained at moderate volumes, as low as 40 and even 25 cycles. The speaker with which most tests were made was the Rola 12MX which has a resonance of about 60 cycles, but this was not detectable in the enclosure nor did it appear to prevent useful output at a much lower frequency.

The 12MX was used because it is typical of a low priced, well designed speaker of a type likely to be popular in moderately priced systems.

Because most of the radiation is provided by the cone, itself, it would theoretically be best to use a speaker with as low a resonance as possible, because the bass efficiency is most likely to hold up until this resonance is passed. But there are other factors, such as power handling capacity, which modify results, and we found the performance of speakers in this class much the same. Perhaps the best of them all is the 12OX, which significantly is rated at somewhat higher power, but costs somewhat more.

CORNER POSITION

As with all these small enclosures, a corner room position is by far the best in the propagation of low frequencies, and in this regard the loading provided by the walls on the back radiation is probably quite valuable. There undoubtedly will be some phase interaction between radiation from the cone and the vent, but this happens in all such cases and must be accepted as part of the pattern. The important point is that, in action, the enclosure provides more bass than any other of its size we have tried, and needs no critical tuning or adjustments to do it. Provided the input is not above normal room volume, it sounds most impressive, particularly if a little bass boost is used to help out.

The cabinet was cut from a single 6ft x 3ft sheet of ½in plywood, although ¾in would be more robust but not essential. If you lay out the dimensions beforehand, you will find it possible to end up with a structure almost 18in square.

Now a few words regarding the speaker baffling: A baffle is cut to fit neatly into the speaker enclosure with an aperture to suit the type of speaker to be used. The speaker may be

(Continued on Page 121)

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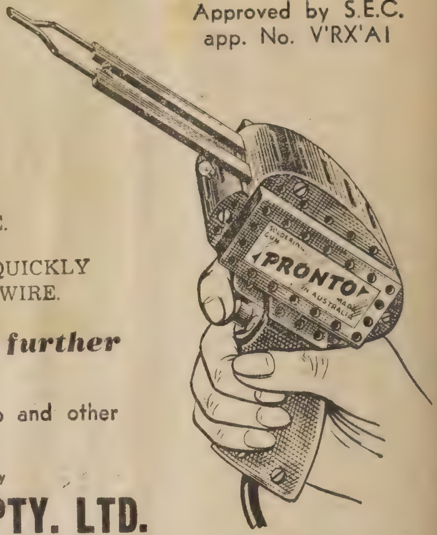

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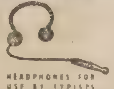
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NEW LAYOUT FOR 17w PLAYMASTER

The circuit of "My Personal Amplifier" detailed in the issue of December, 1957, aroused a good deal of interest among Playmaster enthusiasts, and it seems to have become accepted as a newer version of the original 17-watt amplifier.

BECAUSE the filter choke was elimiinated in the revised circuit, it became possible to build it on a much more compact chassis than that originally used. and which was a carry-over from a standard layout of many years ago.

To save answering individual letters, here are some photographs of a duplicate amplifier built on such a chassis. The layout can well be adopted for 10-watt type amplifiers using the same circuit, and because the components would be smaller, it would even be possible to reduce the dimensions somewhat if there were any great point in doing so.

The amplifier shown here happened to use Bramco transformers, but the space they occupy could just as well be filled by others of different make if so desired. These transformers require a large hole 2¼ inches in diameter to make room for the terminating panel, but an aperture of this size means that almost any other component can be fitted with a certainty connections can be made without trouble.

If a square terminal board is encountered, the worst that can happen is the need for a few hack-saw cuts to square off the corners, a much easier process than cutting square holes from scratch.

CHASSIS SIZE

The chassis measures 10½ x 7¾ x 2½ inches deep. The valve sockets along the front were 1⅛ inches in from the edge and commencing at the control unit connecting socket, the centres, measured from the side of the chassis, are 1⅛in, 2⅝in, 4⅝in, 7¼in and 9¼in.

Along the side which mounts the rectifier and the electrolytics, the centres are 1½in in from the side. Measured from the rear of the chassis commencing with the rectifier, the centres are 1⅛in, 3in and 4¾in. It is always a good thing to lay the sockets, etc., on the plan or the chassis before making the holes to double-check that everything will fit.

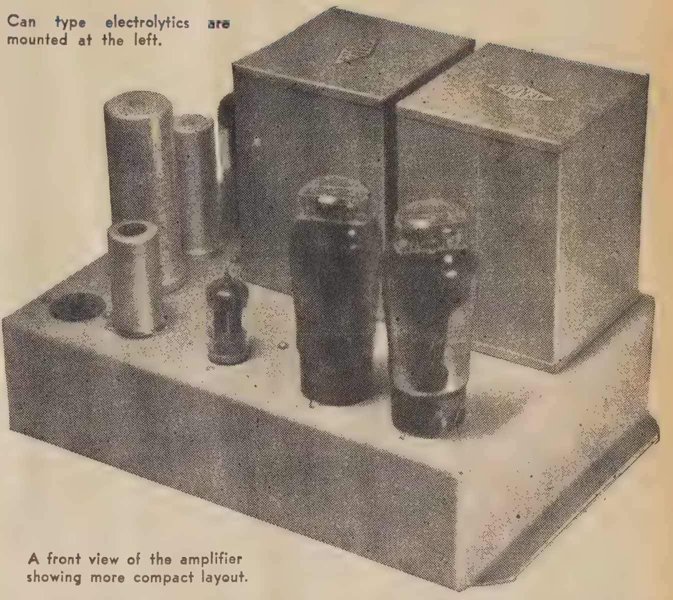
Ideally the electrolytics should be twin 10s and twin 50s, for these fit nicely above the chassis. Unfortunately it isn't always possible to get these without ordering.

I was forced to use some odd values here. The amplifier doesn't know whether can or pigtail types are used, and as long as the total capacitance of each section is sufficient, and the voltage rating adequate, there's no need to worry if you cannot do the same.

I had to add a single 50 mfd pigtail mounted under the chassis where there is plenty of room.

Small ½-watt resistors are much more satisfactory than they used to be, but I like using highest quality 1-watt types in the interest of low noise and stability. In this amplifier I have not followed out my own preferences as I did not have the right types on hand at the time, and I wanted the amplifier urgently. The small resistors are easy to mount—only two tag strips were needed, one near the EF86 and one near the output valves.

Can type electrolytics are mounted at the left.



A front view of the amplifier showing more compact layout.

Some day soon I hope to work out a strip upon which most of these components may be accommodated, thus making construction easier. But the amplifier works perfectly well just as it is.

One alteration I thought a good thing was to use an octal socket for connections to the pre-amplifier rather than the older 6-pin types.

EARTHED PINS

The extra pins allowed me to earth those on either side of the grid pin for shielding purposes. This socket carries AC for the filaments and partially filtered high tension for the tuner and the control unit. Both can transmit hum voltages of small amplitude to the grid pin unless it is protected by such shielding. One of the earthed pins can be used for the earth connecting lead for these units.

To be consistent, the control unit should also have an octal socket at the other end of the connecting lead, otherwise the advantage will be lost. If the amplifier is used with a unit which has a medium to high impedance output, this shielding could well be important. Moreover the octal plugs seem to fit more firmly into their sockets.

In the original article, it was mentioned that the 12AX7 could probably be used in place of the 6SL7 without circuit changes. In practice this hasn't proved correct, as this valve gives considerably more gain than the 6SL7.

FEEDBACK RESISTOR

As a result appreciably more feedback will be applied unless the value of the resistor is increased to 10,000 ohms. This will restore the feedback figure to about 20 db, although 30 db can be applied before instability becomes imminent.

The over-all sensitivity of the amplifier will be increased by using the 12AX7 and mine was a little better than .2 volts. The exact figure may vary according to the output transformer used.

In the Bramco the ultra-linear taps are nearer the plate end of the windings than normal, and this gives less drop in gain as a result.

If used with the Playmaster control units, there is generally enough reserve to work well with input sensitivities between about .2 and .35 volts.

I have been interested lately in the matter of amplifier stability under different conditions of loading, particularly at the high frequency end. In very wideband amplifiers such as this—only a few db down at .5 Mc—the danger of phase rotation under capacitance loading and

by John Moyle

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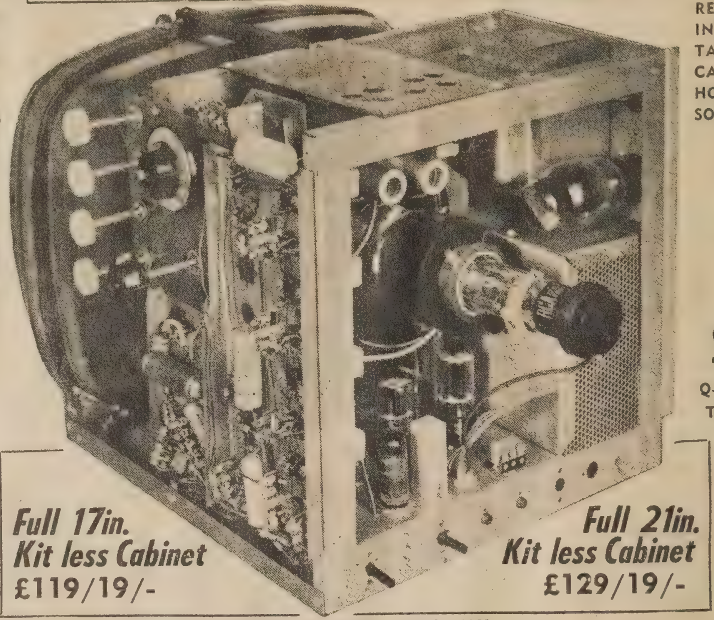

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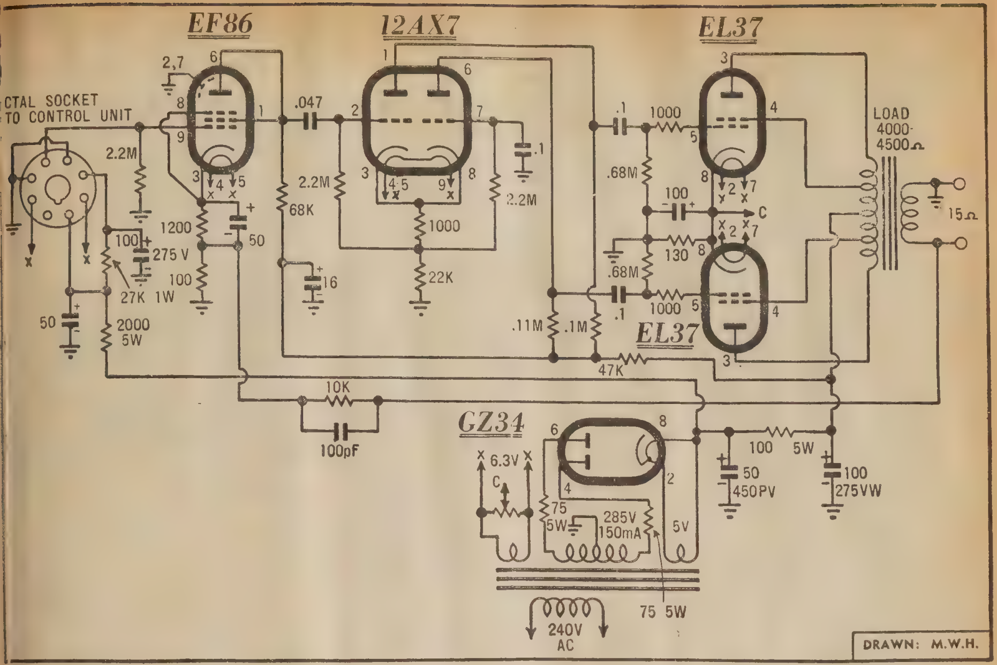


Here is the circuit amended to use the 12AX7, and octal connection input socket.

cisequent ultra-sonic oscillation can be areciable.

deally any amplifier should be stable uler any conditions, varying between on circuit and several mfds of capacitce, but it is easier to write this down tln to achieve it. Amplifier authoriti are noticeably vague on what can b done in practice.

SABILITY

rom experience and observation, it wild seem that such amplifiers are doi well if, in addition to a resistive ld, they do not oscillate with up to . mfds capacitance. This is the general pern of this amplifier. On loudspeaker ld, including a cross-over network, spility is greater, and even with 30ft o light flex as a connection, the same cacitance can be added, and in some ces much more, before oscillation slws up, if at all.

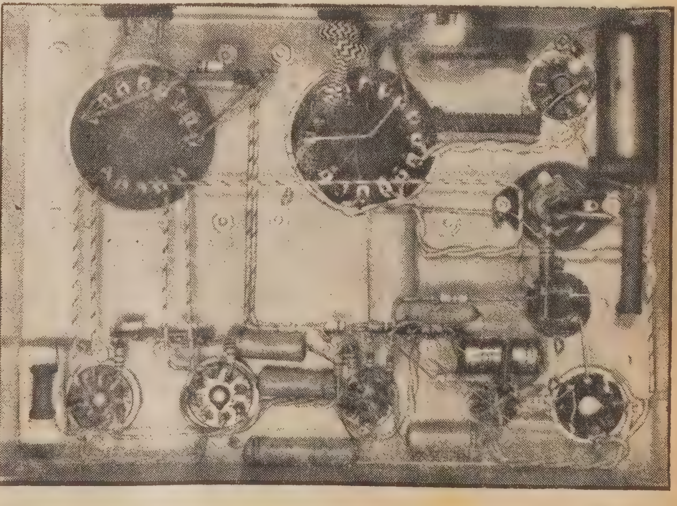
his is at least as good as the average cmercial job, some of which will ollate at full output with no extra cacitance added.

ne way to achieve better stability is t wire a step-circuit across the plate ld of the first valve to severely attente the ultra-sonic response so that rollo commences around about 30 Kc. A le severe cut than this may only accetuate the risk by insufficient attention in the region of dangerous phase st.

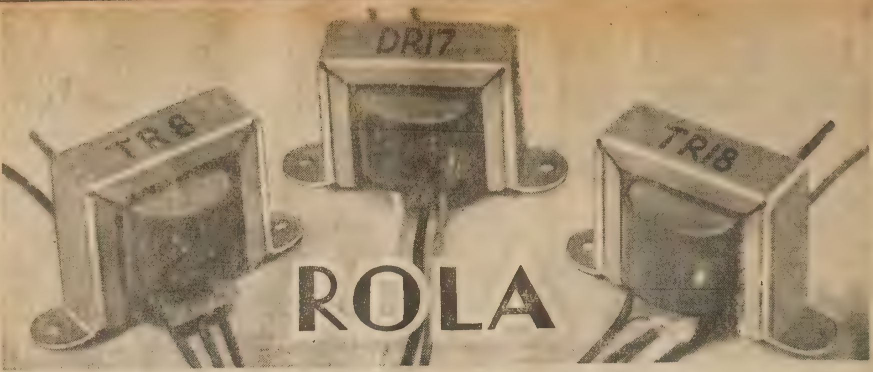
In the case of this amplifier, .001 mfds in series with 5,000 ohms can be used to give performance of this order. Square wave response does not appear to be badly affected, and it is almost impossible to make the amplifier oscillate even with much more feedback.

The subject is too complicated to deal with here, and opinions differ on the wisdom of such devices. Some authorities condone it, others severely condemn what one described as "cooking" responses. From the home builder's viewpoint, it is hard to evolve a set of values which will be reliable over a wide variety of output transformers and other conditions, and for that reason, if the amplifier originally shows no oscillation dangers when operating into a speaker as it was designed to do, maybe there is little point in worrying about its misbehaviour under artificially produced conditions.

Perhaps in the future we can pursue this subject further. In the meantime I would like to hear your opinions if you have experimented with the same point. As a rule, low frequency stability is not a problem with 20 db of feedback.



n under chassis view. The potentioeter provides an adjustable centre p for the early filaments. The tap connected to the cathodes of the output valves.



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They are intended to operate into a standard 3.5 ohm impedance loudspeaker voice coil. In addition to Types DR17 and TR18 which have been designed for the transistor portable described in this issue. Rola also makes other types of transistor transformers. Specifications of some of these are listed below.

ROLA TRANSISTOR TRANSFORMER SPECIFICATIONS

TYPE	DESCRIPTION	IMPEDANCE OHMS	OUTPUT POWER 6 v.	OUTPUT POWER 9 v.
DR17	Driver transformer	3,000 — 2,000 c.t.		
TR18	Output transformer	375 c.t. — 3.5	175 mW	300 mW
DR4	Driver transformer	3,000 — 1,300 c.t.	150 mW	250 mW
TR7	Output transformer	420 c.t. — 3.5		
TR8	Output transformer	300 c.t. — 3.5	200 mW	375 mW

HIGH EFFICIENCY LOUDSPEAKERS

Two small high-efficiency Rola loudspeakers have already been developed for use with transistor or conventional battery-operated receivers and amplifiers. Others are on the way. For this transistorised portable use a Rola Model 5F. For miniature transistor receivers we recommend the new Model 4C-05A fitted with an F44 diaphragm. This speaker measures only 4⅛″ overall by 1¾″ deep, is light in weight—only 6¾ oz. (without transformer), yet has an efficiency equal to that of the earlier Model 4F. Its low cost, small dimensions and light weight make it ideal for miniaturised battery or transistor receivers.

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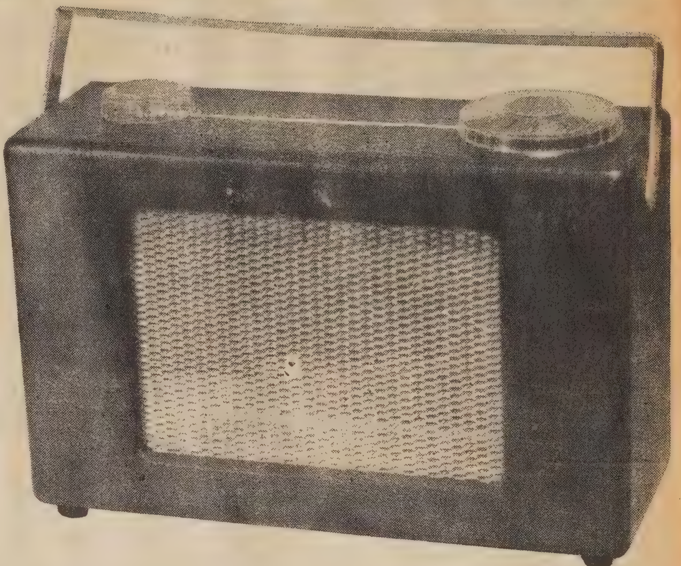
MORE ABOUT TRANSISTOR SETS

Full constructional details of a superhet transistor portable receiver appeared in the August issue, presented in such a way that a near beginner could complete the project successfully. However, there is a section of our readers who would like to understand the design factors which must be considered in transistor receivers and this article is written for their benefit.

by Maurice Findlay



Our "Transporta" looks attractive in its leatherette covered cabinet. This cabinet is cheaper than the polished wood version illustrated in the August issue and probably better suited to picnics and excursions to the beach.

BEFORE discussing details a little general philosophy on the subject of ansistor receiver design may be appro-iate.

Transistor circuitry is, in general, more mplicated than valve circuitry. Most of e tricks of valve circuitry are there us a few special ones, resulting from e transistor's inherent sensitivity to nperature and the internal feedback tween transistor elements.

While present valve circuitry has been e subject of over 30 years of intensive velopment, it is only 10 years since nsistors were invented. Intensive work their circuitry has only taken place in e last five years or so, since transistors ve only been generally available in sonable quantities for that time.

Obviously, it is not fair to compare e development stages of valve and nsistor circuitry on this basis only, sce a large proportion of our owledge of valve circuitry is also ap-lable to transistor circuitry—with dif-ences.

RESENT TASK

At this point in time we are largely a position of adapting transistors to jobs previously done by valves. cause of their small size, low current nsumption and reliability they are e to do many of these jobs more ciently than valves. In the future nsistors will probably be used for jobs ich valves are quite unable to do.

Crystal-ball gazers can already see mpact, efficient electronic computers ed in business houses to speed all types routine calculations and free ployees for more interesting tasks. In tories, transistorised devices will unt production units, check them for ality, length, thickness or any other uired factor.

Checking systems can be combined h a feedback network such that any ors in dimensions or quality are auto-tically corrected by comparison with built-in standard. This will mean not ly faster, cheaper production but better ality goods.

Industrial users have often been slow accept electronic equipment. There been a suspicion of "black box" ices with dozens of knobs and de-lite unreliable valves inside, under-od by a select few and likely to go ong at any moment.

The outlook is now changing. Users finding that many jobs can be done efficiently only by electronic means. The concentration of development on industrial electronic equipment is such that special designs with rugged controls and mechanically arranged to suit the needs of the factory are appearing in increasing quantities.

Transistors will play a major part in the change. Provided they are operated within their temperature, voltage and power ratings, they are inherently more reliable than valves. These factors can almost always be allowed for in the design, so that the chances of the overall equipment breaking down will be much less than the chances of failure in associated mechanical equipment.

The same understanding of the fundamental nature of transistors that is required in the design of receivers is needed in the design of industrial equipment. Perhaps a full understanding of our new transistor receiver will have significance not only in relation to your hobby but also to your job.

With these thoughts as a background, let us consider some of the details of transistors and their circuitry.

The output stage of the receiver is perhaps a logical place to start. From this point we can work our way through the various stages to the converter and the ferrite aerial circuits.

Most valve portable receivers employ a single pentode operating in class A in the output stage and capable of delivering about 200 mW of undistorted power to the loudspeaker. Speaker efficiencies vary greatly but, in general, a power output of less than this would not be acceptable.

Small current amplifier transistors such as the OC70, OC71, TS1, TS2 and TS3 may only be able to deliver powers of the order of 20 mW when operated singly in class A and larger transistors such as the 2N185 and OC72, something like 40 mW.

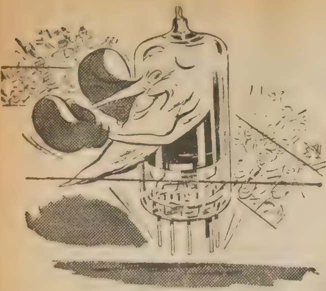
AUDIO POWER

Push-pull operation permits the power output to be at least doubled for class A operation but, by arranging for class B operation, even higher powers can be obtained. A pair of the smaller transistors mentioned may be capable of delivering 100 mW and the larger types from 300 mW to 400 mW.

If a transistor receiver is to have at least as much power output as an ordinary battery portable, therefore, a pair of transistors at least as large as OC72's or 2N185's is required and they need to be operated in class B or a condition approaching class B.

Most transistor portable receivers use an output stage of this type.

Since most valve portables these days use single-ended class A output stages, it is very natural to ask why the same procedure is not adopted in the case of transistor receivers, particularly as the



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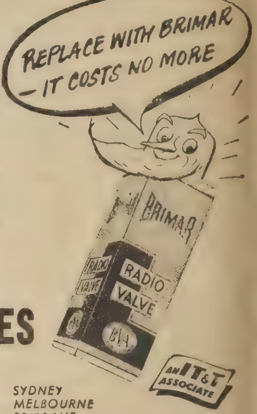

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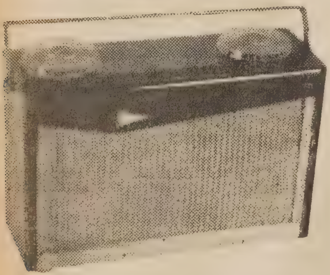

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erall efficiency of the stage is likely be better than that of a similar valve ver amplifier.

)ne factor is the present supply of nsistors. Larger types are not in ticularly good supply and the t one up the range is really too big portable receiver application. It is able of delivering over 2 watts in a gle-ended class A connection and ut 10 watts in class B push-pull. The t is much greater than for two of the aller types.

ven if a transistor of appropriate ngs were available, the case for a gle-ended stage would not be clear.

Vhile it is true that the best way of pling the class B stage to its driver is means of a transformer, this transner is not so difficult to design or tly to produce as an equivalent transner in valve circuits. The reason for is that only a few turns of fairly vy wire are needed. Leakage intances are important but interwinding acitances can usually be kept as low required without any special winding niques.

ANSFORMER COUPLING

ransformers capable of excellent uency response can be produced ply. Simple negative feedback circs can easily be included to ensure the overall distortion is low so that ould not be possible to argue seriouslhat the quality of a class B stage is good enough for a portable.

ssuming suitable transistors, the ice between class A and class B the output stage could easily resolve f into a matter of first cost against ning costs with the single class A e being cheaper initially but dearer un.

will be interesting to see if any ufacturers adopt the single-ended s A stage to save the cost of the ver transformer when a full range power transistors become available. he case of an average receiver, batlife could easily be halved and we that this is too big a price to pay the saving on the driver transformer.

the case of our "Transporta" a of 2N185's, biased for class B ation, are employed in the output e. Conditions are such that the sistors are able to deliver over 300 of undistorted audio at the voice winding of an audio transformer of cal efficiency.

oupling from the driver stage to the s B stage and from the class B stage the speaker is by means of transners in the conventional configurn.

ATERNATIVES

ther arrangements have been prod, a notable case involving a driver sformer with two separate secondbut eliminating the output transner. In addition to the saving in the system allows a higher degree eedback with stability. The high imance voice coil speaker needed can manufactured fairly readily but the irement for a battery of double the age is a fundamental disadvantage.

he parts-supply position rules the me out for the moment.

s with valves, transistors have vol, current and power limitations imd upon them in order to ensure life and reliability. It is interesting to xamine these limitations in relation to the 2N185 power transistors.

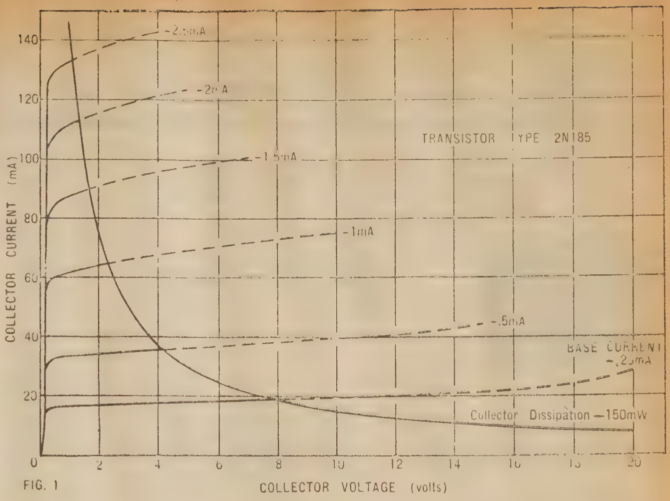

FIG. 1

Characteristic curves for the 2N185 transistor. A pair of these are used in the output stage of the "Transporta." This transistor maintains an excellent figure for Beta up to the highest rated collector currents.

Advanced data on the 2N185's is to hand from Standard Telephones and Cables Pty. Ltd., and we publish a curve of collector current plotted against collector voltage with base current as parameter. The transistor is connected in the common emitter configuration.

This is one of the most useful sets of curves for the design of power amplifiers.

Readers familiar with valve curves will see the general similarity of this set of curves and pentode or beam tetrode curves. Voltages are lower, currents higher than for most valves and the parameter is a current rather than a voltage.

Although the graph is normally drawn in the first quadrant, both the collector voltage and current are negative in the conventional sense and an increasing negative base bias current causes an increase in the collector current.

Two very significant points about the curve are that the collector to emitter voltage with high-base current is quite small (0.2V) and the collector current with zero-base current is small. In practice this means that the collector can be swung along a load line from almost zero current to almost zero voltage and the practical efficiency of an output stage can approach the theoretical of 50 p.c. for a class A stage or 78 p.c. for a class B stage.

Limitations on the operation of the transistor can effectively be illustrated on the curve.

OPERATING LIMITS

One limitation on the transistor is the temperature of the germanium. This is governed by the ambient temperature, the power dissipation and the amount of cooling provided. If no special heat sink or other cooling method is provided, the limitation on the 2N185 is 150 mW. Since power is the product of voltage and current, the 150 mW dis-

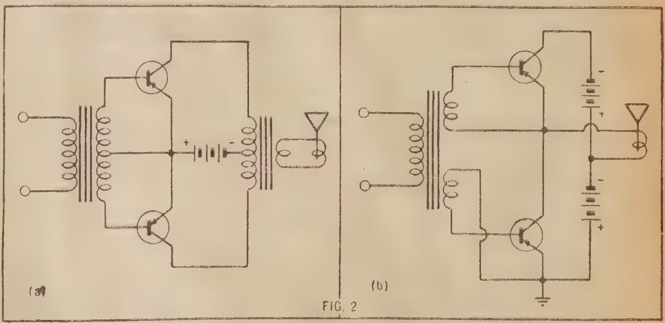

FIG. 2

Conventional wiring method for a push-pull output stage (a) and a single ended push-pull stage (b) which eliminates the output transformer. The main disadvantage of the latter would appear to be the need for a battery of double the voltage. The centre tap can be omitted by the use of extra components. Bias details are omitted from both diagrams.

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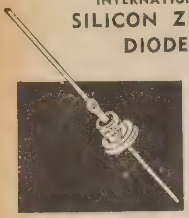

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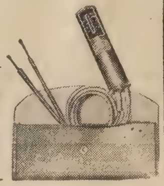

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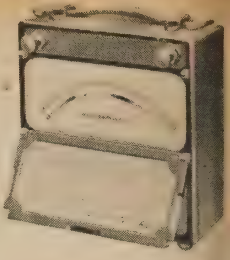

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tion limit can be shown by a hyper- drawn on the graph.

t higher than normal temperatures heat dissipation required for the ger- ium to reach the limit temperature ld obviously be less. Any required t may be illustrated by a hyperbola lar to the one shown. The smaller dissipation, the closer the hyperbola he current and voltage axes.

ollector current in the case of the 85 must not exceed 150 mA. This t is shown on the graph by a line llel to the voltage axis. Similarly. peak collector potential must not ed 20 volts illustrated by a line llel to the current axis. A point to h here is that for inductive loads peak collector voltage can be up to ole the supply voltage.

he 2N185 is mostly used in this and the supply potential should nally not exceed 10 volts.

ERATIONAL LIMITS

order to ensure normal service the transistor, the quescent oper- point should lie within the boun- s of the voltage and current axes, voltage and current limits and the imum dissipation hyperbola.

is permissible to operate the tran- r into a load such that the operating t passes instantaneously into a on exceeding the permissible heat pation but the time it operates in region should be small compared the thermal time constant of the sistor and sufficient time should be t at points of lower than maximum pation for the average to be equal r less than the maximum.

frequent practical case is that of an ctive load which is represented by liptical load line. The instantaneous ctor dissipation may well exceed the issible average maximum.

uch the same thinking applies to -operating conditions. Some revision stified because we are dealing with miliar quantities.

e effect of junction temperature on amily of curves should be consider- ext. This is a phenomenon which not have a clear parallel in the of valves.

the negative terminal of the supply ry is connected to the collector and ositive terminal to the emitter, with base open circuit, a small current flow. This is referred to in the litera- as Ico'. One of the objects of tran- designers is to keep this value as as possible.

e value of Ico' is not constant but ases with temperature in such a way each 10 degrees centigrade causes proximately to double.

GH TEMPERATURE

terms of the curves, this has the of pushing the whole family up ollector current axis by the amount e increase. Collector dissipation is ased, which increases the junction erature and the value of Ico' still er.

is is a form of positive feedback in h the thermal characteristic of the istor forms part of the feedback and if the increase in current is iently great and the heat dissipating y of the transistor sufficiently low, result in an unstable condition. Wh this happens the increase in cur- is only limited by the current capa- of the battery or the transistor.

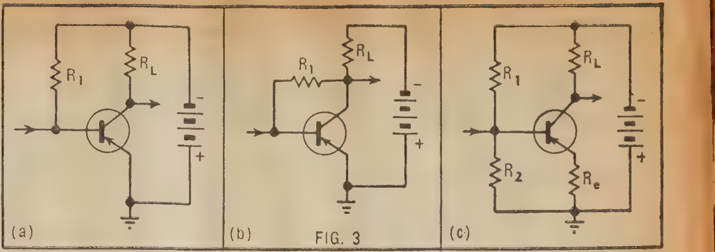

FIG. 3

Three methods of providing bias for transistors. Coupling components, etc., are omitted. (a) Fixed bias. (b) Self bias. (c) Bias arrangement employing direct current feedback for thermal stabilisation. The latter is most often used in practice.

With most small transistors it is the transistor which breaks down first and it is described as having "run away."

In a good design, the worst possible set of conditions must be taken into account. The circuit should remain stable with the highest supply voltage, the highest ambient temperature and the greatest collector dissipation likely to be encountered.

One way to improve thermal stability is to employ a heat sink: a substance with a large thermal capacity in good thermal contact with the collector of the transistor. Safe collector dissipation of the transistor can often be increased greatly by this means, particularly in the case of large transistors where special trouble has been taken to have the collector in good thermal contact with the body of the transistor.

This method is not used in the "Transporta" because the 2N185's can deliver the required power without heat sinks.

The problem can also be attacked from the circuit angle by including an arrangement of resistors which automatically reduce the base bias current when Ico' increases, tending to keep the collector current at a constant value.

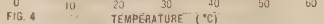

FIG. 4

Temperature/resistance characteristic of the CZ9A. Note that its resistance is about 330 ohms at normal temperatures and about 150 ohms at the highest temperatures transistor receivers are likely to encounter.

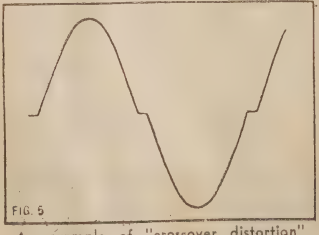

FIG. 5

An example of "crossover distortion" due to too low a value of forward bias in a class B push-pull stage.

Some stabilisation of operating point is almost always necessary in transistor circuits.

There are a number of methods and variations, some involving a second battery supply, but two bias circuits cover all the applications you are likely to meet in ordinary receivers and amplifiers.

Looking at the diagram (Figure 3), the circuit at (a) is included only to point out its disadvantages. It is referred to as fixed bias because the bias current is fixed and depends on the battery voltage and the value of R1. The voltage drop between the base and emitter of the transistor is usually small (0.1v.) compared with the supply voltage (say 6v. to 9v.) so that the value of the resistor is simply the supply voltage divided by the required bias current, with sufficient accuracy for all practical purposes.

The forward bias for the required operating point will be found from the curves or from a manufacturer's table of typical operating conditions. However, the operating point will shift with changes in temperature as described earlier.

If the load happens to be the primary winding of a transformer with a low D.C. resistance the increased current will lead to increased collector dissipation and under the worst conditions could result in the destruction of the transistor.

WITH RESISTIVE LOAD

If a relatively high value resistive load is used, a high junction temperature will cause the operating point to run up the load line and, if taken to the extreme, to saturate in a high-current, low-voltage condition. Even if the saturation or voltage cut-off point is not reached, the signal-handling capacity of the stage is impaired. This circuit is not often used.

If the load is a transformer primary with a low D.C. resistance, the circuit at (b) is the same as (a) from a D.C. stability point of view. When the load has substantial resistance, an increase in Ico' will increase the voltage drop across the load and hence the supply potential for the bias resistor R1.

The circuit is, therefore, to some extent self-regulating and is a worthwhile improvement over the simple circuit at (a) with no additional components. The value of R1 is quite easy to calculate because you will know the voltage at the collector from the desired operating condition. You can neglect the bias current through the load.

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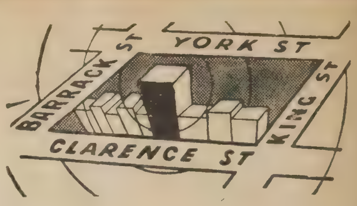

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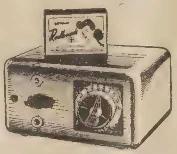

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There is some negative feedback through R1 but values are such that it can usually be neglected. Feedback may be eliminated but this involves two extra components. A better design would probably go to circuit (c), which overall involves one additional resistor in a practical circuit.

The circuit at (b) is very useful where the signal amplitude is low and some shift in the operating point can be accepted. It is easiest to design circuits of this type, to remain operative over a wide temperature range, if the current gain of the transistor (Beta) is relatively low.

The most generally useful circuit is shown at (c) and requires four resistors in all, including the normal load resistor. All except one of the stages in the "Transporta" use this basic form of stabilisation for controlling the DC operating point. In the two RF and the output stages, AC loads appear between the stabilising circuit and the transistor terminal. However, the DC resistance of these loads can be neglected in considering the effect of the stabilising circuit on the DC operating point.

STABILISING CIRCUIT

A resistor is placed in the emitter circuit of the transistor. At the same time a potential divider across the supply line provides current for the base.

Assume that resistor values have been chosen so that the transistor is operating with rated bias current and rated collector current. The latter will flow through Re, causing the emitter to be slightly negative with respect to earth.

If now the temperature increases, causing the standing current through the collector and emitter circuits to increase, the voltage drop across the emitter resistor will also increase, tending to make the emitter more negative with respect to the base.

This is the same as making the base more positive with respect to the emitter and, of course, decreases the forward bias current, tending to maintain the current which was flowing before the temperature rise.

The degree of stabilisation depends on the emitter resistor. Larger values give better stabilisation because a given change in current results in a greater change in the voltage drop across the resistor. A compromise must be found because the voltage drop across the resistor is subtracted from the supply voltage and results in wasted power.

WASTE POWER

Similarly, the values chosen for the voltage divider (R1 and R2) are a compromise. From the stability point of view, the lower the values of these two resistors the lower the value of the two in parallel and hence the source resistance of the equivalent series DC supply. With low values, the potential at the base will vary little with changing load current. The forward bias current will then change rapidly with changes in the voltage drop across Re.

However, the lower the total value of the divider, the greater the power wasted and the greater the load on the previous stage.

Sometimes, it is convenient to use a temperature-sensitive resistor in the divider circuit. Thermal stability of the circuit can often be improved and at the same time the standing drain through the divider reduced by the choice of a suitable resistor.

In the case of the "Transporta" output stage a parallel combination of fixed and negative temperature co-efficient resistors is used for R2. When the temperature rises, the effective value of R2 decreases, and the forward bias on the output transistors decreases, tending to decrease the standing collector current.

The correct forward bias over the full range of operating temperatures is of the utmost importance in the output stage where too high a value increases the battery drain and the power dissipation of the transistors, while too low a value can result in "crossover distortion" (Figure 5). The transition break between the two halves of the cycle can be sharp and the distortion at low volumes very objectionable. This applies even more with transistors than with valves, where the break is not always so sharply defined.

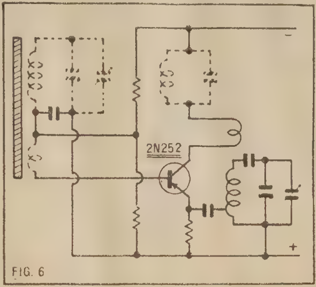

FIG. 6

The converter can be considered as basically a transistor oscillator with signal and intermediate frequency circuits in series with the essential oscillator elements. Interaction is not too great because of differing frequencies.

CAPACITOR NECESSARY

Negative feedback is practically useless for removing crossover distortion, because the loop gain is low at the point of crossover and, although a high value of feedback may be operative over the remainder of the cycle it has no effect when neither transistor is conducting.

A 0.1 uF capacitor wired from collector to collector of the output stage serves to attenuate severely transients appearing at the output stage of the "Transporta," due to any likely combination of temperature and transistors.

Feedback from the voice coil winding of the output transformer to the emitter of the driver transistor assists in reducing distortion in both the driver and output stages. Depending on the particular transistors used, the feedback is from 10 to 12 db and combined with the high peak power available from the transistors, makes for really excellent portable quality.

The original Standard Telephones and Cables recommendation suggested about 6 db of feedback, the feeling being that a greater amount of feedback could result in oscillation, particularly at the high frequency end of the audio range, with certain combinations of driver and output transformers.

While a carefully chosen shunt capacitor across the feedback resistor would have allowed more feedback, S.T.C. felt that manufacturers would like to avoid the cost of an extra component.

Our own view is that readers would like to have the benefits of the extra feedback at the expense of the capacitor. However, if you would like to leave the capacitor out, the present 330 ohm resistor should be replaced by a 680 ohm unit, when the feedback will be about 6 db.

Operating conditions for the driver transistor are worthy of some consideration. In order to drive the output transistors to full output a definite peak voltage and current is required. A good design usually allows a reserve of drive so that the output stage always overloads before the driver.

A TS2 has a good reserve of drive for a pair of 2N185's and it is worth spending a moment considering the factors which influence the final choice of transformer ratio.

DRIVER TRANSFORMER

If the transformer is given a high step-down ratio, the driver transistor collector voltage will cut off at zero and double the supply voltage before the required peak base to base drive voltage is developed.

On the other hand, if the transformer is designed with a step-up ratio, the maximum current ratings and/or collector dissipation of the driver transistor will be exceeded before the required peak current is developed at the output transistor bases.

Since the former involves the least current drawn from the supply, it is the preferred limit condition. The transformer primary impedance should be chosen so that the output transistors are overdriven by a factor of the order of 1½ : 1 when voltage cut-off occurs.

The source impedance of the driver is high compared with the change in output transistor base impedance throughout the cycle, no matter what the practical transformer ratio chosen, because the AC collector impedance of the driver transistor is of the order of 20,000 ohms. Therefore the drive is essentially of the constant current type.

The non-linearity of the input diode often compensates the non-linearity of the base/collector transfer characteristic in power amplifiers and distortion is less with low impedance drive. This is not often practical because of the high current drain required and because a design relying on feedback to attenuate the small distortion components involved is far more economical.

The "Transporta" calls for a 3,000-ohm to 2,000-ohm CT transformer, which is a good practical choice.

FIRST AUDIO STAGE

Design of the first audio amplifier is mainly a matter of finding a combination of collector load and forward bias resistors which will not cause the transistor to cut off in either a voltage or a current sense at the extremes of the temperature range.

The load resistor must be high enough for the transistor's dissipation not to be exceeded at any operating point. There is no point in going to very high values, even if this is possible, because the shunting effect of the following stage (the input of the transistor in parallel with the bias network) is only of the order of 600 ohms.

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he input resistance of the first audio sistor is somewhere about 1,000 ohms this must be considered in the de- of the detector stage and also in choice of coupling methods.

ne general configuration of the de- or circuit is the same as used in a receiver. Naturally a germanium e is used and the entire circuit oper- at a fairly low impedance in order uit the characteristics of both the e and the following circuit.

ne diode load must be low compared the reverse resistance of the diode high compared with the forward tance for good detection efficiency. the same time, in order to handle -signal modulation percentages with distortion, the ratio of the AC to the loads must be as high as possible.

ooking at the circuit on page 33 of August issue, you will note that the t of the TS1 is directly in shunt the diode load when the volume rol is in the maximum position. The load is then very much lower than DC load.

ISTOR SAVED

order to overcome this defect some ns include a resistor in series with ase of the TS1. For a given volume ne loudspeaker, the volume control has to be turned up further and it s out that the AC load is little rent to that when the resistor is ted.

ne advantage of leaving the resistor is that extra gain can be achieved very weak stations when required. fact that the distortion will be er under these conditions is not important. Also the cost of a re- r is saved.

addition to extracting the audio the intermediate frequency signal, detector provides an automatic gain rol potential proportional to the age value of the signal. This is ap- to the 2N308 intermediate ampli- and helps to keep the audio level tant with signals of varying strength in the presence of fading.

ven suitable initial operating con- ns, the gain of the IF transistor can e steadily reduced by reducing the er current. Since the emitter cur- is a relatively large value and would equire a relatively large amount of r to control directly, a more eco- ical scheme is to control the base ent of the transistor and allow it to ct as its own DC amplifier.

A.C. TIME CONSTANT

the "Transporta" the AGC bias is ped through a filter consisting of a 2,200-ohm resistor and a 50-uF capa- cit. The detector diode polarity is so chen that increasing signal strength ates an increasing positive potential e developed by the detector and, rugh the filter network, to subtract the standing negative bias on the N308.

fficient control can be obtained by means to cope with all but the gest signals. We took our original atory model right under the shadow e aerial of one of Sydney's power- broadcast stations and, provided the het was orientated for least signal pickup, the quality was quite acceptable. unlikely that the average user will pate his receiver under similar con- ns.

auxiliary diode, which obtains a bias from the IF amplifier and shunting the first IF tuned circuit under strong signal conditions, has been suggested and we have carried out some experiments along these lines. However, the present circuit is perfectly satisfactory, and we do not wish to go ahead with the auxiliary AGC system until we are certain that it has sufficient advantages to justify the extra cost.

Type 2N308 is a grown-diffused junction transistor designed for use in IF amplifiers at the normal intermediate frequency of 455 Kc, and is capable of giving a gain of the order of 40 db at this frequency.

UPPER FREQUENCY

Most of the alloyed-junction transistors of the type used in audio amplifiers would only be capable of providing gains of this order up to about 50 Kc.

The performance of transistors at high frequencies is often compared by quoting the frequency at which the current amplifiaction factor is 3 db down, with the transistor connected to the common base circuit. This is referred to as the alpha cut-off frequency.

In practice, even at high frequencies, higher gain is obtained in the common emitter circuit and this connection is nearly always used. At the same time, for the highest gain the alpha cut-off frequency should be 10 or more times the operating frequency.

The input impedances of transistors suitable for RF amplification are quite low by the standards of valve engineers. Samples from different manufacturers we have seen vary from about 500 ohms to 5,000 ohms. The 2N308 is towards the high end of this range.

Tuned circuits with the required working Q and designed to have the transistor connected across the entire winding would have an inconveniently high value of capacitance, and be difficult to design. A better approach is to design tuned circuits with the conventional ratio of inductance to capacitance and tap the base at an appropriate point down the coil.

TRANSISTOR IMPEDANCES

Similar considerations apply in the case of the output impedances where variations between about 20,000 ohms and 0.5 meg. could be encountered. Again, the 2N308 is toward the high end of the range.

For maximum gain the tap point would be adjusted so that the output load is matched to the dynamic output impedance of the transistor and so on, but this is not always practical because of selectivity requirements. Better selectivity can be obtained by tapping the transistor further down the coil and sometimes this is the more important consideration in a receiver with a limited number of stages. Gain can often be made up in the audio stages.

Considerations of transistor gain, input and output impedances, as well as loaded and unloaded Q's and mutual inductance of coils, all interact to determine the final gain and selectivity of the IF amplifier.

If the equivalent circuit of a transistor is drawn, it will be found that it includes both a resistive and a capacitive component from collector back to base. With certain transistors it is possible for this feedback component to result in oscillation and a circuit to cancel both the resistive and capacitive components must be included. The amplifier is then described as having been unilateralised.

An important advantage of the 2N308 is that the positive feedback component is very small and in many circuits it can be operated without unilateralisation. We have checked transistors with greater feedback components than the 2N308 in the receiver and they do appear to work satisfactorily. However, there is reason to believe that their performance would be better in a more suitable circuit.

CONVERTER

Many of the remarks regarding the IF amplifier also apply to the converter stage. Here we use a 2N252 transistor in the "Transporta." This type has input and output impedances generally similar to the 2N308 but is capable of operating at even higher frequencies.

The converter section combines the functions of an oscillator covering the range from approx. 1.0 to 2.0 Mc (signal frequency plus 455 Kc) and a non-linear amplifying device for combining the local oscillations with the signal to produce the intermediate frequency.

These functions can be performed by two transistors, one to act as an oscillator and one connected for best performance as a mixer. This system has the advantage of allowing the application of AGC to the mixer where it can be more effective than on the IF amplifier.

However, it has been found that, on the broadcast band at least, the signal and intermediate frequency circuits can be placed in series with the base and collector of an oscillator transistor respectively to allow it to perform the functions of both mixer and oscillator. The gain will be 6 db or so down on that of the same transistor operated as a straight amplifier. Even so, it could be expected to be of the order of 30 db.

BIAS CONDITIONS

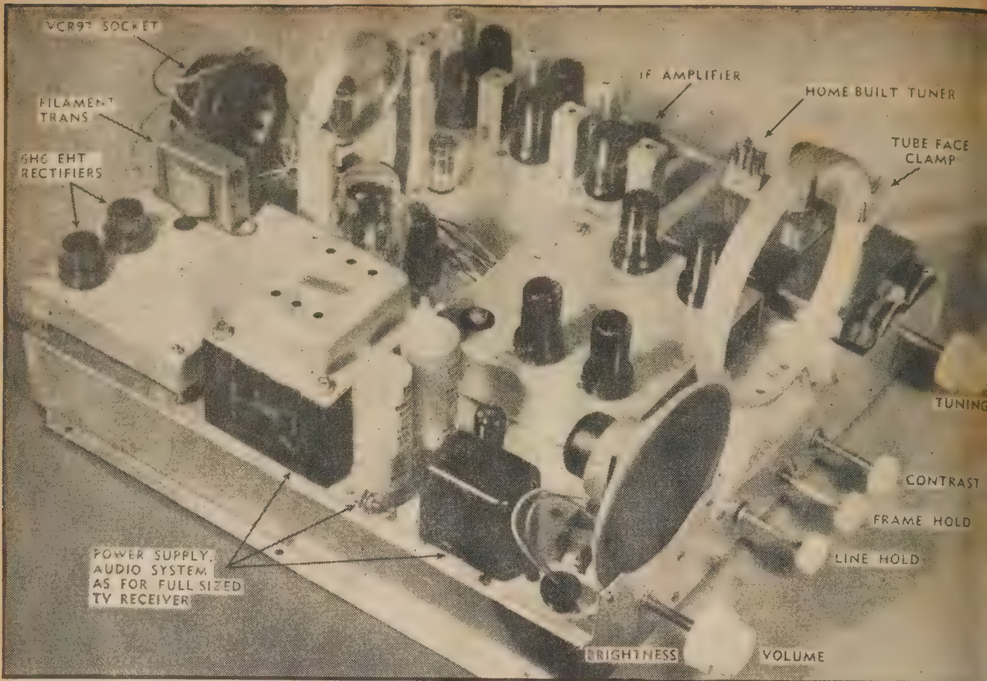
Initially, the transistor is biased for linear operation with the normal thermal stabilisation circuit as used in other stages of the receiver. This ensures that the oscillator commences to operate on the application of the supply.

As the amplitude of oscillation increases rectification at the emitter changes the average bias applied to the transistor and tends to drive it into a non-linear condition which is required for mixing action. The amplitude of oscillation is stabilised as the operating point of the transistor passes from the linear region.

Average collector current increases only slightly with the converter stage oscillating, making it difficult to judge the amplitude of oscillation from DC measurements. However, the crystal diode probe attached to the Senior Vacuum Tube Voltmeter proved the value of its low loading, enabling the amplitude of oscillation across the oscillator tuning capacitor section of the gang to be measured with so little detuning that the change in volume of a station with the probe on and off could not be noticed.

The RMS amplitude with an average transistor and a new battery measured in this way varied between about 2.5V at the high frequency end of the band and 1.5V at the low frequency end of the band.

(Continued on Page 127)



This photograph shows rather more clearly than was possible last month the sub-chassis carrying the 6AC7 deflection amplifiers—in the centre, below the picture tube—and the EHT supply in the left rear corner. Note that, if hum patterns are observed, the entire EHT chassis should be rotated through 180 degrees to bring the filament transformer adjacent to the edge of the chassis.

1958 TV Set With 5BP1 Tube

Last month we described a method of adapting our 1958 TV Receiver for temporary use with a VCR97 disposals CRO tube. This month, we have a little more to say about the scheme, with particular reference to the use of 5BP1 type tubes.

LOOKING back over the completed circuit, it certainly impresses as being a lot of gear for a small picture and the same is true of any further ideas and adaptions suggested in this present article.

However, the vital point to remember is that the suggested arrangements are not an end in themselves but a planned step toward a complete, conventional receiver.

CHEAP CRO TUBE

They are justified only on the assumption that the CRO tube has been bought very cheaply and that the other temporary valves and components necessary for electrostatic deflection have likewise cost next-to-nothing.

On this basis, television programs can be enjoyed for a much smaller initial outlay than would otherwise be the case, and a lot of very useful experience gained as well.

Later, when the family purse will stand the cost of a regular picture tube, with its deflection and EHT components, the CRO tube and its associated paraphenalia can be stripped away, literally in a matter of minutes, and the new circuitry added.

Viewed in this light, the whole proposition can be a very attractive one for a home constructor whose enthusiasm runs somewhat ahead of his resources.

As indicated last month, the VCR97 is the obvious choice for such a program, because it has been available cheaply and in large numbers and it can be used with much the same brightne focus and video circuitry as regu picture tubes. However, supplies of VCR97 have dwindled markedly of l and the question of using other ty naturally follows, notably the 5BP1, mentioned earlier.

by *Neville Williams*

MOST PLENTIFUL

5BP1's have probably been the che est and most plentiful of all the posals CRO tubes and, even at rather remote date, limited supplies still coming forward.

They are often regarded as the Am can equivalent of the VCR97 but, wh used for similar purposes in radar other equipment, they differ in imp ant details and are not necessarily in changeable in home-built television ceivers.

Physically, the 5BP1 is smaller lighter than the VCR97, with a 5in meter screen and a conventional 11- base. This last is an advantage, if o ause sockets to suit it are fairly dily available.

he 5in screen looks quite small inst the 6in VCR97 but the differ- is not as great as might appear irst glance. The 5BP1 has an almost screen and the deflection electrodes so placed that the whole area can scanned.

hus, while the picture is not quite ig as from the best VCR97's (nota- the E-405-B-16 types), it is actually er than that obtainable from other 97's, in which the scanned area is ted.

BP1's appear to have been manu- ured to a quite uniform physical pat- but, as with other wartime CRO s, their brightness and focus modu- n characteristics are subject to a deal of variation. In general, the 5BP1's fall short of the best 97's in all three respects but the re is still quite useful, nevertheless.

T MUCH DIFFERENCE

e deflector plates are relatively l and placed very close to the gun ture so that there is little differ- in the deflection sensitivity of the nd Y plates. On the other hand, deflector plates in the VCR97 are large, one set being necessarily away from the gun.

ese remote plates give about the deflection sensistivity as those in BP1 so that, for frame deflection, e is little to choose between the two . However, the plates nearer the of the VCR97 have an advantage lmost 2:1 so that, for the more lt job of line deflection, the 97 is almost twice as sensitive as BP1.

tunately, the horizontal amplifiers t month's design have just enough e to swing the 5BP1, even at or bove its maximum EHT rating of volts. With a more typical figure 00 volts, there should be a small n of reserve.

art from the added deflection dif- es, the picture is likely to benefit r keeping the EHT up near the um figure for the tube and, in ce, the EHT supply shown last is likely to centre at about 2.2KV.

H VOLTAGE

have no indication as to the toler- f 5BP1's to slight over-voltage but be reduced, if desired, by using . capacitors in the EHT supply, e optional values are shown and by reducing in value the first 2fd capacitor.

far the greatest disadvantage of P1's, for our present purpose, is e cathode sleeve is connected in- y to one side of the heater. This it impractical to follow usual tele- practice of operating the heater a common source and applying modulation and brightness control cathode.

principle is used in our 1958 r design and caused no difficulties he VCR97 featured last month. it does have separate connect- r heater and cathode, even though acitance between the two is rath- the high side.

only way the 5BP1 can be used in this fashion is to operate its heater through an isolating transformer, either a 1:1 type fed from the existing heater circuit or one stepping down from the mains voltage. The video and brightness voltages can then be applied to the base pin which is common to cathode and one side of the heater. (Pin II for the 5BP1).

CAPACITANCE IS HIGH

The immediate difficulty of the scheme is that the normal stray capacitance to earth of the video circuit is augmented by the capacitance of the heater supply winding, both to the primary and to the frame of the isolating transformer.

It is difficult, in practice, to get these last below about 60pF, without using large laminations or operating with excessive flux density. As a result, the net shunt capacitance is likely to be very high and the video loss significant, even with a small picture.

We hooked up a 5BP1 to try the scheme, using a commercial low-capacitance filament transformer, and it certainly works. However, remembering that a special filament transformer is already required to operate the 6H6 EHT rectifiers, the arrangement is not likely to appeal to readers other than those who have facilities to "roll their own."

If you have such facilities, or don't mind the cost of a special transformer, the modifications to last month's heater/cathode circuit are as indicated.

The alternative scheme of applying video and brightness to the intenstiy grid poses the immediate problem that the sense of the voltages required are just the reverse to those provided in the original design.

Instead of simply running the cathode to pot. across the HT line, for brightness control, a source of variable negative bias has to be found — and it certainly isn't provided in the original design.

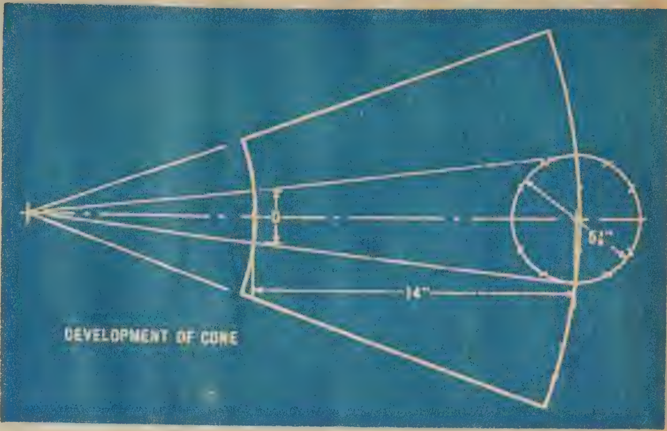
SUPPLIES AGC

Again, the detector in the original circuit provides negative-going signals for synch. pulses and black level, the voltage being filtered for AGC purposes.

The negative-going signal is also applied to the video amplifier grid, appearing at the plate at a positive-going signal. This is suitable for application to the synch. separator and also modulates the picture tube correctly when fed to the cathode.

If fed to the grid of the picture tube, it would obviously produce a negative image, black areas being white and white areas black.

MAGNETIC SHIELD FOR 5BP1 CRT

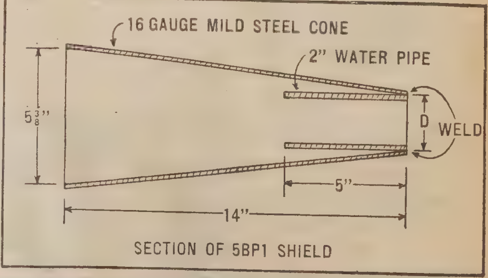


Development of a mild steel shield cone for a 5BP1 tube. Begin by making an elevation drawing of the completed cone. Continue sides until they meet. With this point as centre, draw arcs to pass through the corner points of the elevation drawing. Step off circumference around the larger arc. For a lapp joint, another ¼ to ½ inch would need to be allowed.

☆

A section view of the completed shield. A short length of 2-inch water pipe, welded inside the narrow end, provides additional shielding for the gun assembly.

☆



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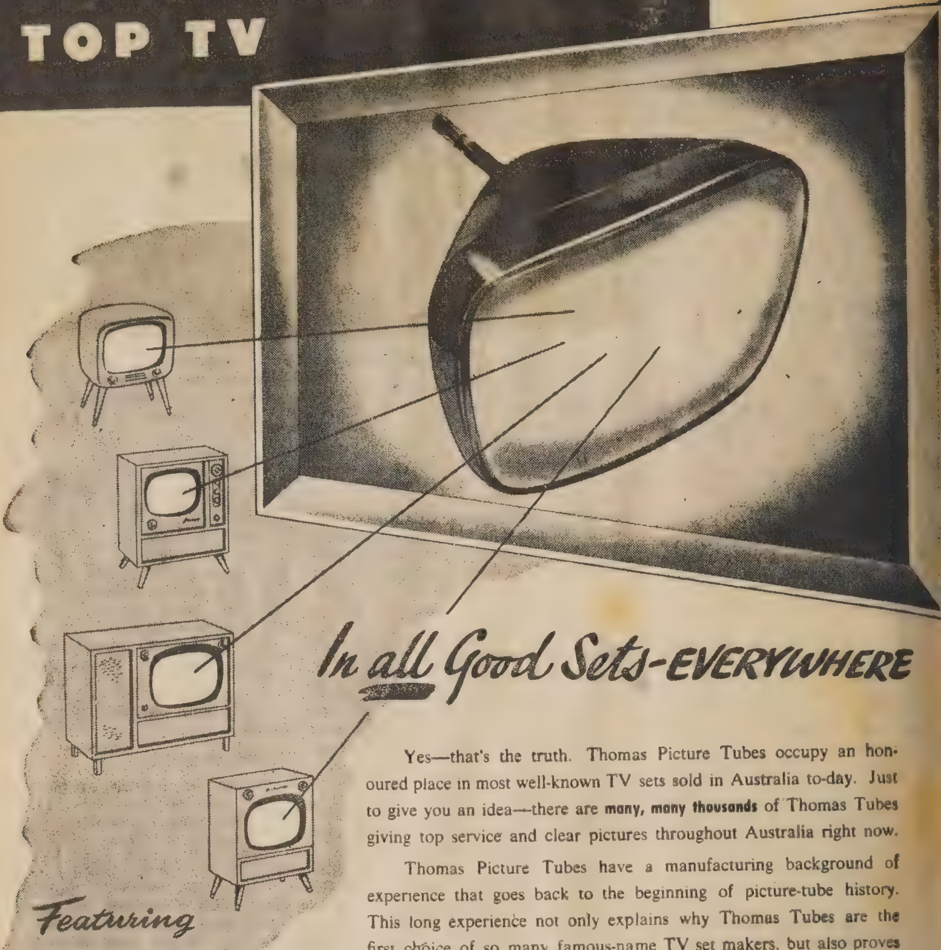

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versing the diode detector would inly give the right picture phase with, but it would also invalidate AGC, apply positive instead of neg- bias to the video amplifier grid cause the synch. separator to reject r than to reproduce the synch. s.

provide grid excitation for the e tube, as for a 5BP1, it is clearly sary to add a second video stage, will reverse picture phase, while ig AGC and synch. separator cir- intact. This, in addition to the sion of negative bias for brightness ol, as already mentioned.

ATIVE BIAS

point of fact, the provision of ve bias presented no great prob- being provided by another 6H6, a r and a couple of capacitors. The components can either be accom- ed on the temporary EHT chas- else hung by short, stiff leads to iring of the main chassis.

indicated in our circuit, the 6H6 is operated from the main 6.3 ource and the cathodes earthed. lates are then shunt fed from one f the power transformer through volt .05mfd. capacitor. The re negative voltage is filtered by a g. resistor and a couple of capa- r before application to the normal g. brightness pot.

ugh specified as 0.47mfd., the fil- pacitors can be anything from this upward and with a voltage rating volts or more. Alternatively, a decrepit electrolytic would pro- do just as well at the junction of o resistors.

lying the remaining problem it be- obvious that the second half of rame oscillator/output valve, a or 12BH7, is at present unused ight therefore be made to serve ideo amplifier, mainly to reverse cture phase.

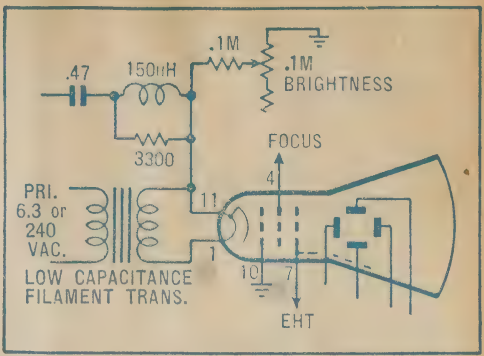
leaving undisturbed the wiring of BY7 — the video amplifier pro- and the feed to the synch. separ- orrect separator operation would ained. In other words, the phase would apply only to the signal to the 5BP1 grid.

RI CIRUIT

the 6CM7 is quite handily for the purpose, it was only a few s work to wire its grid to the nents, originally intended to serve pture tube cathode, remembering to the 0.1meg. return resistor, in- f leaving it connected to the nor- rightness control. This last, any- eeds to be rewired to the neg- ias source for grid control.

high gain is not required from ditional triode section, it is con- ie to use a cathode resistor with very small bypass, sufficient to sate the high frequency response. resistors supply the plate, one normal load resistor back to and the other a feedback resistor e plate circuit of the 12BY7.

a 1meg. resistor can be used 5BP1 grid circuit, a coupling or of 0.1mfd. is ample to ensure w frequency response.



☆

Because the 5BP1 has an internal connection between heater and cathode, it cannot be used with conventional cathode input for video and brightness. An isolating transformer can be used as shown but it must be designed with the lowest possible capacitance from secondary to primary and frame.

☆

By connecting the extra triode section in this fashion, the basic wiring for the 12BY7 need not be disturbed, while the extra few components can be added in a matter of minutes.

Happily enough, the frequency response works out quite well, being substantially flat to 3Mc with the Contrast control at maximum resistance. It falls away in the 4Mc. region, tending to rise again toward 5Mc, due to the influence of the improperly loaded peaking and trap circuits. However, this is plenty of video for a 5BP1 to resolve.

The gain of the extra triode can be manipulated by varying the value of the 68K feedback resistor, lower values reducing gain and vice versa.

Insufficient video gain must obviously prejudice the performance of the receiver in weak signal areas, while too much gain may give excessive contrast where the signals are strong. Some experiment may therefore be necessary to establish optimum circuit conditions, in relation to your particular site, aerial, receiver and, last but not least, your particular 5BP1.

WIDTH COIL IN 1958 TV RECEIVER

A few readers appear to have been confused about the connection into circuit of the width coil in our 1958 TV Receiver. Where there is any doubt, we suggest that connection diagrams, etc., be ignored and the lugs identified by inspection or, better still, by the use of an ohmmeter.

The connection common to both coils, shown in our circuit as a tapping, must go to lug 1 on the line output transformer. The larger coil, with a DC resistance of 13.6 ohms, must connect to lug 2 of the line output transformer, while the smaller coil, with a resistance of 3.8 ohms, is wired effectively in series with one lead to the yoke. In other words, the connections must be strictly as shown in our main circuit diagram, on pages 56-57 of the May issue.

We have come across two or three cases where wrong connection of the coil has produced undesirable effects, notably insufficient width and/or strong ringing patterns at the left-hand side of the screen.

One complication of the whole scheme is that the effect of feedback and of gain in the extra tube conspire to lower the signal level at the 12BY7 plate. This means, in turn, that a somewhat smaller signal reaches the synch. separator, making the line lock a little less "automatic" as the receiver is switched from channel to channel, with low contrast and very weak signal input.

However, with normal contrast levels, line lock is quite good and, in any case, a mere touch on the control is sufficient to bring it into synch., with virtually no chance of it losing it thereafter. We preferred to leave the circuit in this form rather than try to modify signal levels in a way which might involve wholesale rewiring of the video amplifier proper.

MAGNETIC SHIELDING

As with any other CRO tube, within the stray field of a power transformer, some 50-cycle deflection of the beam is likely to occur. This can vary from a slight weave in the picture to complete break-up, running slowly up or down the picture according to the difference frequency between the mains and the crystal-locked frame frequency.

If you bought your 5BP1 in a piece of radar gear, the chances are that it will be fitted with a shield, which will greatly diminish such unwanted deflection. (Note that the shield should be earthed to prevent it from acquiring an electrostatic charge.)

Enclosing the narrow end of the tube in about seven or eight inches of water pipe should also help matters, or else in a couple of overlapping half shells made from 16 gauge mild steel. In either case, provision would need to be made to support both shield and tube.

For those who have the facilities to make something more effective and ambitious, we would remind readers of the excellent shield which was developed for our Wide Band Oscilloscope, and mentioned in the March, 1957 issue. This was made from 16 gauge mild steel, plus a small length of water pipe.

The drawings are reproduced here for reference, showing how the shape is developed on a flat sheet and also the finished dimensions. The joint should be ideally butted and seam welded, though an overlap can be provided for and either rivetted or spot welded.

A cone of this shape can be supported on the main chassis and will, in turn,

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rt the tube, if a few strips of felt ued to the inside to prevent dan metal-to-glass pressure.

r and above the VCR97 and the a few five and six inch CR tubes been available, but only in such numbers that lengthy discussion m is hardly warranted.

ical of these is the 5CP1, a tube we have not actually tested our- It has a separate cathode con- n and could therefore be used much the same circuitry as sug- last month for the VCR97.

re is also a separate connection 3, allowing this electrode to be ed at up to 4KV. One or two s who have used the tube this ay that it is very good, although fference between it and the 5BP1 marked when operated with a on voltage in the vicinity of 2KV.

VCR112

ther five inch type is the VCR- his is a rather long tube (18½ins) seven-contact clip type base and ap connections on the side of the

on the tube is somewhat con- It is listed as having a green but we have seen some samples green screen, others with bluish On past experience, the latter ot been very good, possibly due en deterioration during long peri- storage.

on hand lists the heater as four t one amp but, again, figures pen- on individual tubes, as well as our of the tubes themselves, sug- at the true figure is 0.7 amp. published data on the basing so proved to be in error. The ontacts on the side of the neck A3 and the two Y plates. These ones furthest from the cathode uld normally be used for frame on.

these contacts pointing upwards oking on the end of the base, widely spaced base contacts are X plates. Progressing in a clock- rection from these, the first of sely grouped contacts is for grid, d by cathode and one side of ter (on a common contact) then er side of the heater, then A1 ally A2.

e tubes which we were able to the cathode lead is brought out ly and joined to the particular pin within the base. It could pre- be separated, therefore, and r cathode injection and brightness as for a VCR97.

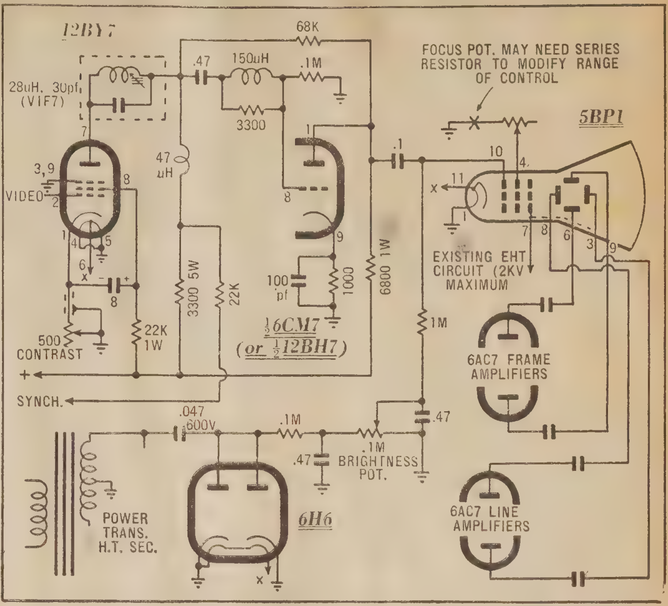
NECT TO HT LINE

onal rating for A1 in the VCR112 to be about 250, so that it can wired directly to the normal . To obtain focus, it may be y to wire a resistor of 0.25meg abouts in series with the earth- on to the focus pot, in order to e range of focusing potential sitive direction.

in this fashion, the tube gives e same image as a 5BP1, per- trifle brighter.

nly other 6-inch tube which we ortunity to check was the VCR- is longer than the VCR97 and milar base and connections, ex- at the positions of grid and are reversed. Data indicates that

EXTRA TRIODE INVERTS PHASE



To accommodate a 5BP1 temporarily in the 1958 TV Receiver, it is necessary to provide a negative bias for brightness control and to wire the unused section of the 6CM7 or 12BH7 as a video amplifier to invert the signal phase.

the maximum permissible A3 potential is 3.5KV and that the tube can be used with electrostatic or magnetic deflection and focus.

However, it would appear to be a most unpromising tube for even simple television receivers. The screen is a two-step type having an initial very deep blue colour, and lacking in brightness when operated with 2 to 2.5KV on A3. The blue fades to a greenish-yellow afterglow which, contrariwise, has too much brightness and persistence to be ignored.

LARGER TUBES

Over and above these 5 and 6-inch types, a good deal of interest has centred on the use of 12-inch tubes, mainly because they would appear to offer the chance of a much larger picture for relatively small outlay. Their use is attended by a good many complications, however.

First and foremost, the placement of the deflection electrodes is restrictive in some cases, such that it may not be possible to use the whole screen area. In fact some individual tubes, presumably designed for A-scan radar, will deflect only three or four inches in one direction before the beam strikes the plates. Even assuming that these plates are used for frame deflection, the overall picture which can be obtained is still quite small.

Over and above this problem, which may or may not arise, there may be difficulty in deflecting the beam over a substantial screen area, due to the onset of amplifier overload. Unless the deflection amplifiers are carefully adjusted for maximum peak voltage output, the picture size obtainable may be little more than with a 5 or 6-inch tube.

This statement is on the assumption that not more than about 2.5KV is applied to the tube, and it raises yet another point. For a given EHT voltage, the electron energy available to energise the screen may not be very different from that in a smaller tube, so that similar brightness will be obtained with pictures of the same general size.

If the picture can indeed be successfully enlarged on the bigger tube, the brightness will decrease more or less in proportion to the increase in area. It will naturally vary with individual tubes but our impression, from those we have seen, is that the average picture so obtained could only be viewed in complete darkness, and then with nothing to spare.

MUCH GREATER EHT

The fact is, of course, that the larger tubes are intended for use with an EHT of 4KV or even more in some cases. This will naturally increase picture brightness but it will likewise so diminish deflection sensitivity that conventional amplifiers, operating at 300 odd volts, will not be able fully to deflect the beam.

We have not ourselves had opportunity to push the matter any further but it would seem that, to get the best out of the 12-inch tubes:

(1) They would have to be operated with an EHT of not less than 4KV and,

(2) The voltage amplifiers would need to be supplied from 500 volts or even higher, due regard being paid to the

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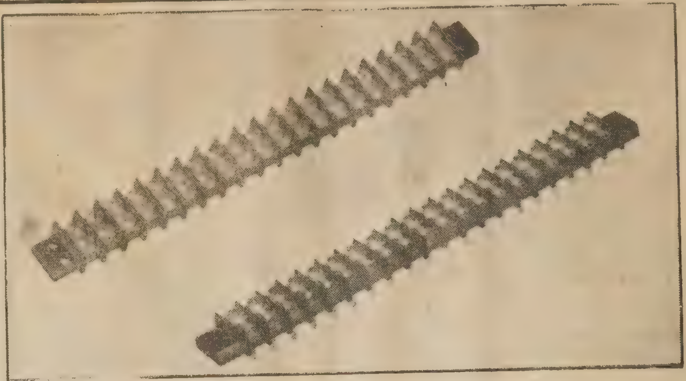

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ation of valves and plate loads.

th resistance coupled amplifiers, of e, there is substantial voltage drop the plate load resistors, so that a high supply potential can be used ut raising the plate or screen tials beyond their permissible This would be true, in general, e 6AC7 amplifiers shown in last 's circuit.

king the time to effect such es, we nevertheless tried a couple ailable tubes in the VCR97 set-up, plugging them into the same after reversing the connections to rid and cathode pins.

the two, we preferred the type 31 This gives a green picture the same as the VCR97 and 5BP1. is tube, we were able to expand the to approximately 8in x 6in be- ncountering amplifier overload and or plate limitation, both at about me dimension

HTNESS POOR

particular VCR131 focused well with the limited EHT voltage, ness was well down and, as men- earlier, insufficient for viewing in ng but total darkness.

hould be noted, by the way, that ater current of the VCR131, as ome other 12-inch tubes, is 1.1 so that the dropping resistor from lts is near enough to 2 ohms.

ther tube which we tried was the 11-A. General behaviour of this vas much the same as the VCR- st mentioned, except that it has a ersistance screen, which makes it itable for television viewing.

image colour is a light green, n after-glow of much the same This after-glow is not nearly as as in the VCR87 mentioned and does not detract too serious- n ordinary scenes. However, large of illumination do linger into suc- pictures.

VCR511-A has a 6KV maximum but we have had no reports on aviour with this voltage applied. ld certainly be rather difficult to

ross-Talk Suggestion

ew cases have come to our notice builders have experienced notice- ross-talk effects on the left hand f the screen. This manifests itself avy pattern in the horizontal lines, ing between one and two inches ming no obvious wiring or com- errors, the cases referred to would to be due to variations in indivi- okes, even though these variations still be within the manufacturer's ence. One reader investigated this bm at some length, trying modifi- of both the yoke damping com- and circuitry within the cage ifying the yoke components did ld any encouraging improvement, components in the cage were It was eventually established that 0 pf, 2,500 volt capacitor be- pin 3 of the TH02 and the 10K sistor was the most critical com- one. Reducing it to 47 pf almost tely cured the trouble in this par- case. It is perhaps significant that alues have been shown in AWV n various occasions.

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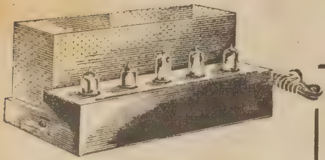

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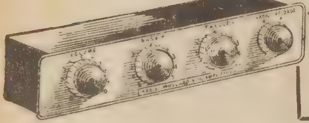

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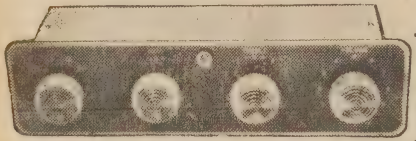

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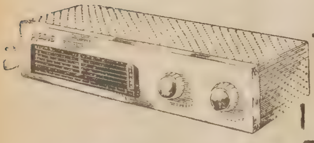

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t, there is no reason why anyone lful enough to have progressed , should not undertake this final ven if he has never tackled a job before, a project as simple should hold no terrors. Only a ls are required and there is noth- ly difficult or complex about the be done.

he other hand, the final result st attractive little cabinet in a ontemporary style, for which you ake no apology. On the con- ou will be proud to tell your that you made it yourself

ake the project as simple as pos- have prepared a detailed draw- ing all the essential dimensions, s, and method of assembly. Fol- arefully and there is little chance untering any serious problems. material used is 3/8in thick ply top, bottom and sides and 3/16 the front and the speaker We suggest that the waterproof ded" ply is to be preferred, being e to splinter when cut.

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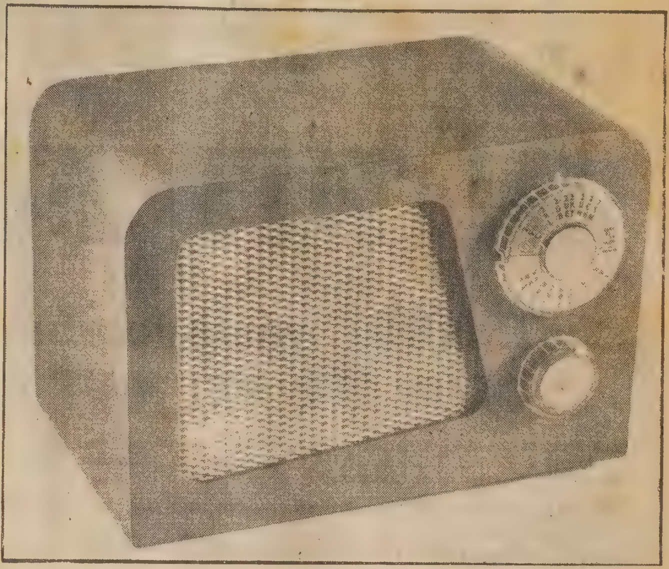
el pins, ¾in.
ein glue.
anded aluminium, 6 x 7in. approx. (Gold).
ll tube plastic wood.
ll tin of undercoat.
ll tin glossy enamel or lacquer in chosen colour.

llowing tools will be required:

d saw, preferably a panel type.
or coping saw.
e.
are.
d rasp, half round.
mer.
s or garnite paper in coarse, medium and fine grades.

is, of course, a "right" and side to the plywood, so be sure it your work with this point in can be seen from the drawing, es of 3/8in material are required and the dimensions are clearly shown.



The finished cabinet with the set fitted. Finished in green, it contrasts nicely with the gold knobs and speaker grille. Other colours will suggest themselves and may be more suitable for use with particular room decoration.

These should be carefully marked out on the ply, with adequate space between each section to allow for the thickness of the saw cut, plus 1/16in or so to allow for final finishing. When sawing do not cut right to the line but keep this approximately 1/16in on the waste side of it.

Each piece is then dressed to actual size with the plane. This should be set moderately fine (material once removed is not easily replaced) and each side planed from the end toward the centre. Carrying the plane along the full length will only result in splintering the wood at the far end.

When all four pieces have been accurately dressed, they may be temporarily assembled as shown in the drawing. Note that the bottom piece is mounted inside the two side pieces for greater strength. Panel pins are used to hold the sections together, but should not be driven right home at this stage.

It is a good idea to check the major dimensions at this stage, just to make sure that no silly mistakes have been made, and also to check that the assembly is square, or capable of being made square when the front is fitted.

by Philip Watson

The front is cut next, using the 3-16in ply and measures 10 x 6¾in. Once again, leave about 1-16in waste to allow for exact dressing to final size. However this last step is best left for the moment, and the front simply tacked to the body to help square up the latter, and provide a check for minor discrepencies.

SPEAKER CUT-OUT

The speaker opening in the front should be completed before the latter is finally fitted in place, the depth of the cabinet making it difficult to accommodate the average fret or coping saw. As before, cut close to, but not right against, the line. The final dressing is done with the wood rasp or coarse glass paper.

Now we can consider the job of glueing all these parts together. We have suggested a cold water casein glue in preference to the "hide" or "animal" glues usually used by professional cabinet makers, since it is so much easier to prepare and use in small quantities. This makes it ideal for the home constructor who needs only a small amount at short notice.

Mix the glue by following the makers instructions carefully, which generally require that the mixture be allowed to stand for about 10 minutes before using. Mix no more than is likely to be required immediately, since it cannot be

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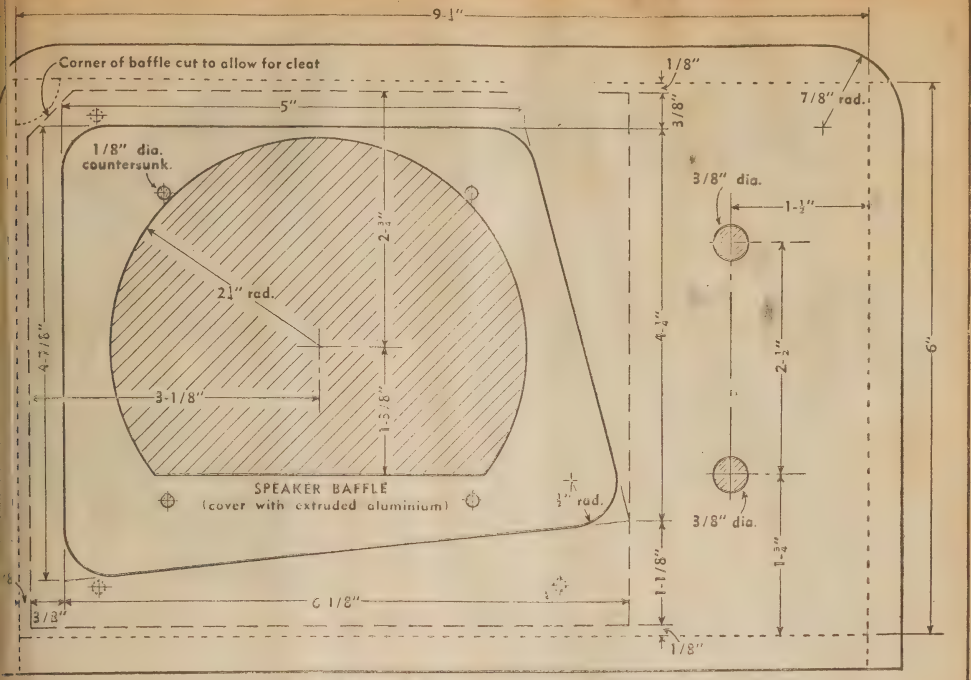
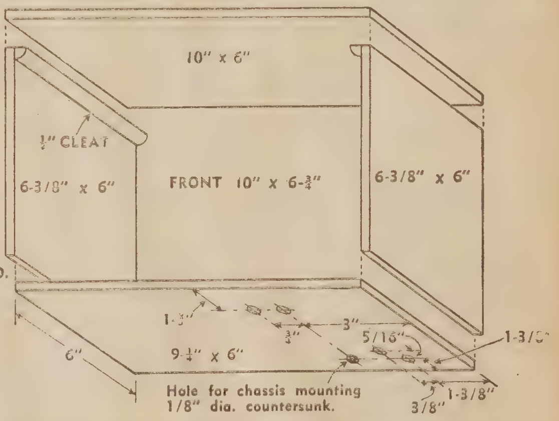

9-1/4"
Corner of baffle cut to allow for cleat
1/8"
5"
3/8"
7/8" rad.
1/8" dia. countersunk.
3/8" dia.
1-1/2"
2-3/4"
2-1/4" rad.
4-1/4"
4-7/8"
2-1/2"
6"
3-1/8"
1-3/8"
SPEAKER BAFFLE
(cover with extruded aluminium)
1/2" rad.
3/8" dia.
1-3/4"
1-1/8"
6 1/8"
3/8"
1/8"

CABINET FRONT (with baffle in position)

Assembly diagram of top, bottom and sides. Diameter of holes unmarked are 1/4" and are positioned for easy adjustment to aerial and oscillator trimmers and coil cores in aligning receiver.

TTOM AND SIDES ARE 3/8" PLYWOOD,
NPIECE AND SPEAKER BAFFLE ARE 3/16" PLYWOOD.


10" x 6"
1/2" CLEAT
6-3/8" x 6"
FRONT 10" x 6-3/4"
6-3/8" x 6"
1-3/4"
3"
3/4"
5/16"
1-3/8"
6"
9-1/4" x 6"
Hole for chassis mounting
1/8" dia. countersunk.
1-3/8"
3/8"

CABINET DETAILS FOR BEGINNERS' FOUR

awing should provide all the dimensions and other information needed to allow any beginner to set out the job with a minimum of effort.

rre than a couple of hours. A
poc of powder will probably make
e for this part of the project.
e ıct that the cabinet has already
aembled will simplify the job of
nling quickly and accurately
e glueing process. Simply prize
es apart, leaving the panel pins
und the holes for these in the
vhen re-assembling, the pins are
ushed back in the same holes
whole job comes together with-
ulty.
airst stage we will assemble and glue the sides, top, and bottom. We will also fit the front, but without glueing it, its main job at this stage being to keep the rest of the assembly square.

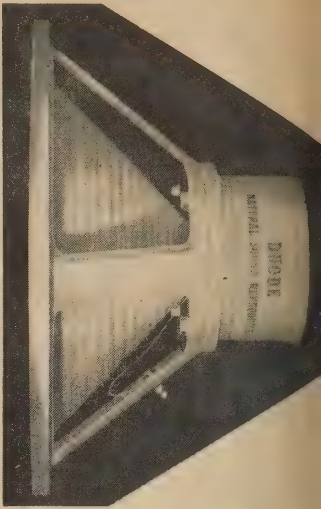
Cover the surfaces to be joined with an even and moderately liberal coating of glue, taking particular care not to obliterate the panel pin holes. When all surfaces are coated, re-assemble with the aid of the panel pins and drive these right home. Remove the surplus glue with a damp cloth and leave to set. This will require several hours and is best left overnight.

When set, remove the front and fit the two cleats of "quad" moulding in the two corners. These are needed to strengthen these corners in preparation for subsequent rounding, and will remove a substantial amount of material.

These are simply glued in place, but it is necessary to exert some pressure until the glue is set. Clamps may be used if available but, if not, they may be held temporarily with panel pins. However, in the latter event, be very sure that all the panel pins are subsequently removed. Otherwise there is a very real

THE MUSIC LOVERS' LOUDSPEAKER

DUODE



WHAT CONTROLLED IMPEDANCE DOES

The impedance of all loudspeakers varies considerably with the frequency unless steps are taken to prevent it. Laboratory tests on a number of high quality loudspeakers revealed that it is not unusual for 15 ohm units to measure 60 ohms at their bass resonance and at 12Kc/s. Your amplifier cannot give a flat response when faced with a load that varies in this way.

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r of one showing up during sub- nt planing operations, with disastr- esults to the plane.

the same reason, the pins driven h the top and into the side pieces l be withdrawn once the glue is ly set. Be particularly careful to at all pins are accounted for be- sing the plane.

front still requires to be dressed : and fitted. The first part of the ng may be done with it removed he body, but fitting it to this from o time to check the progress. The tage may be done with it actually o the body, thus ensuring a perfect hen this has been achieved it may ed permanently in place.

radius of the corner curve is on the diagram, and this should be d out on the front of the cabinet a guide. Since a fair amount of al has to be removed, it is best d with the plane, at least until nal stage is approached. Plane ront to back, first at 45 degrees major amount of material has emoved, and then at lesser angles duce the required curvature. The ressing may be with coarse glass er

ATIC WOOD

his stage the job should be ex- carefully for small defects, such pped or splintered edges, surface es, nail holes, etc. These should ted with plastic wood, allowing rise above the surface slightly to nsate for subsequent shrinkage. nel pins securing the front should ched slightly below the surface n covered with plastic wood.

ly, the whole cabinet should be with glass paper, finishing with grade to give a smooth surface. with the grain for the best finish: cross it.

ing is the next job, and you will bt have your own ideas regard- table colours. We chose an at- jade green — called "art green" makers — and this contrasts most ely with the gold knobs and grill. Another suggestion is glossy which also goes very well with d fittings. Much will depend on rior decoration with which it is sed, remembering that a bright f colour can often be most ef- in the right part of a room.

RCOAT

ever, regardless of the colour the first thing to do is prepare od with several coats of good surfacer or undercoat, dressing at with fine glass paper before g the next. Particular attention be given to the rounded corners, he wide variety of timber grains t essential that this part is well

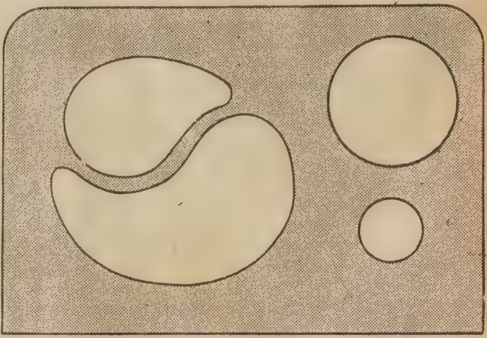
when the entire cabinet has essed to a smooth even surface the final colour be applied. coats will normally be required the best results. We used a spray- quer applied with a simple hand spray gun, but a brushing will probably appeal to most rs, and is generally safer in un- hands.

final piece of woodwork is the e. This is made from 3/16in ply nasures 5¾ x 6½in. As shown in the diagram a partly circular hole is cut to match the speaker cone area and one corner is cut to accommodate the cabinet cleat.

Since the baffle fits against the front of the chassis there will be a thickness of metal between it and the speaker. To allow for this and permit a better fit between speaker and baffle, the latter needs to be modified so that the lower portion (which fits against the chassis) is thinner than the main portion.

Removing one layer of ply almost exactly compensates for the thickness of metal and is quite easily done. A line is drawn parallel with the bottom of the baffle and about 1¾in from it, and is then scored with a sharp knife until the first layer of ply is cut through.

Now peel off this layer by inserting the knife underneath it on the edge of the ply. The timber will probably splinter and come away in strips, but the ragged edges will not extend beyond the line already cut. Small portions on timber or glue which remain may be removed with coarse glass paper.



There are many possible variations of speaker cut-out which will alter the whole appearance of the cabinet. Here is one suggested by our artist, but there is no reason why you should not think out something for yourself.

The baffle is fastened to the speaker with four countersunk bolts, two of these being those already used to mount the speaker on the chassis. The other two are at the top of the speaker.

The piece of expanded aluminium is fastened to the baffle by means of countersunk screws near each corner, taking care that they are located behind the cabinet front. Note particularly that there is a right and wrong way up for this material. It should be so mounted that the speaker is not readily visible when viewed from above or either side.

Another job which must be done before the set is finally fitted is to drill ¼in holes in the bottom of the cabinet to provide access to the aerial and oscillator trimmers and slugs. These holes are shown on the drawing as accurately as possible, but minor variations are inevitable and your own chassis should be carefully measured before finally drilling these.

SECURING THE CHASSIS

The chassis mounting hole nearby is not so critical, provided it does not call for a hole in the chassis in an awkward spot. A 2¼in long, 1/8in diameter countersunk bolt is used to hold the chassis in place, and is quite effective.

Concerning the controls, there may be one or two minor modifications necessary. The volume control shaft may be a fraction too high for the hole position we have shown in the cabinet, but this latter is desirable to preserve a balanced appearance. Rather than risk spoiling the cabinet layout, we suggest that the volume control be removed and the mounting hole be elongated in a downward direction for approximately ¼in. using a rat tail file.

The other possibility is that the gang shaft (which is rather shorter than we would like it to be anyway) may not protrude as far through the front of the cabinet as desirable. There is no chance that it will be too short to take the knob, but there may not be enough to allow for any slight eccentricity on the part of the latter, causing it to foul against the cabinet.

If this should appear to be so it will be necessary to move the gang forward slightly to make full use of the available shaft length. There are several ways in which this can be done, but the simplest seems to be that of fitting it with a modified front mounting bracket.

We made such a bracket from a scrap of aluminium, using the original bracket as a drilling template but increasing the distance between the front of the bracket and the rear holes. In the case of the rear mounting studs, it is only necessary to drill two new holes in the chassis, moved forward by the required amount.

This treatment will probably not be necessary in most cases, but it is handy to have some idea of how to go about it if it should be necessary.

FINAL ALIGNMENT

With the set finally mounted in the cabinet any final alignment adjustment can be carried out. This will mainly involve the dial calibrations and adjustment of the oscillator slug and trimmer to provide any necessary correction. It should be followed by aerial slug and trimmer adjustments to secure maximum sensitivity. Refer to last month's article for a detailed description of this procedure.

Some form of reference mark is required in conjunction with the tuning knob and we provided this quite simply by pushing an ordinary pin through the front panel, just above the top of the knob, the head providing a useful but unobtrusive mark.

And that just about winds up our description of the cabinet, as well as this series of articles. If you have followed them carefully, you should now be close to finishing the project. We trust it will perform as successfully as our own, and that you have really learned something while you were building it.

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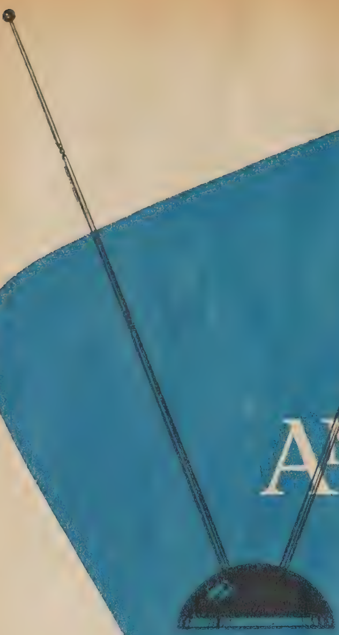

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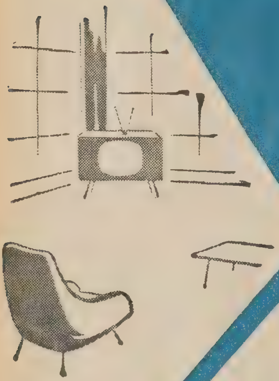

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

ME CONTROLLER FOR PHOTOGRAPHIC ENLARGER

A etter from Mr B. M. Byrne, Indooroopilly, Qld., during month contained the circuit a very simple timer suitable a photo enlarger. Since io and photography are two bies which seem to run toner, many readers will be inrested in his comments.

correspondent has apparently had nce of the frustrations of attempt time enlarger exposures precisely e aid of a watch or an ordinary kork timer equipped with a gong. ote some of the points made in er.

Ts device has the following fea-

1) xtreme economy of operation.

2) omponents and wiring are most ncritical (apart from any normal fety considerations in wiring 40-volt circuits.)

3) implicity of operation. Push the utton on the trailing flex and larger comes on. When it goes f it is ready for re-operation.

4) ompact construction possible.

device consists of a self-rectifyer valve with a relay in its plate operated directly from the secar of a power transformer. It is with a 20,000 ohm cathode reo near cut-off, under which conhe relay is inoperative and the is open. This relay controls the g of the 240V mains to the enlug on the apparatus chassis.

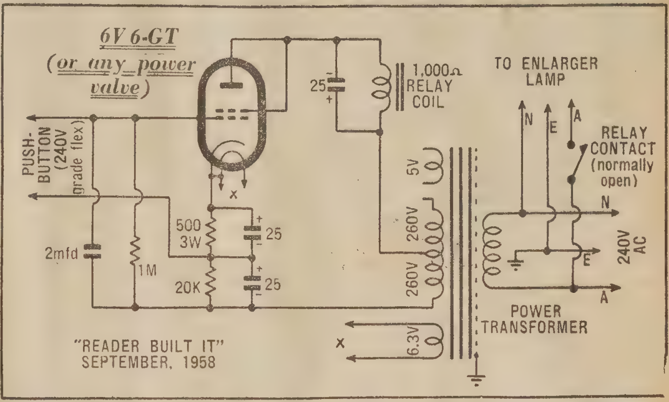
EOF RELAY

relay I used was an old ex-Serepment type, with a microswitch hl. If the body of the relay is and access barred by an insulaer, practically any relay will do, it will operate at about 15 to and release at 1 to 2 mA. If stents are possible, so much the r. If a higher current relay (i.e. at 40 mA, release 8 mA) were e grid capacitor C could be into about 10 mfd. This is, howmore difficult value to obtain

ating the push button (on a suitulated twin plastic flex) reduces voltage to near cathode voltage ively short-circuiting the capaci. Plate current, filtered by C3, rough the relay which operates is on the enlarger lamp.

On eleasing the button C, which has volts bucking, the voltage across 2K cathode resistor discharges through R, taking about 10 seconds, in the circuit shown, to reduce the plate current to relay release value.

"Resistor R can be replaced by a potentiometer if variable timing is required. For my purpose, it is not."



The circuit requires a minimum of parts. Various combinations of valves and transformers could be used. This would affect the time of exposure but compensation could be made by varying R.

A Professional Finish for your Panels

Mr R. B. Rooke, of Eastwood, N.S.W., has some interesting comments to make on panel finishing methods.

"The following is a highly satisfactory and permanent method of marking panels for receivers, amplifiers, test equipment and the like. It is assumed that the panel has been suitably painted previously, although the particular ink used can be applied to bare aluminium or other metals quite satisfactorily.

"From a rubber stamp dealer obtain a bottle of 'Indelible Metal-Marking Ink,' either black or white according to personal preference. If the panel is a light colour, e.g., light grey, the black ink may be more suitable, and vice versa. The correct ink is quite opaque and 'full-bodied' and dries to a hard paint-like finish.

"Marking is carried out in the main with the aid of a lettering stencil and pen, of the 'Uno' type.

"Lettering is most conveniently carried out before the panel is fitted. Normally, with home-built equipment, changes may be made right up to the final wiring, so this is best left to the last.

If possible the work should be carried out before holes for control spindles, etc., are cut. However, if the panels have been worked the job can still be carried out quite successfully by laying it on a sheet of heavy card of some sort, with a centring line drawn on the card, running across the space left by the hole.

"All main control lettering can be carried out with the stencil set. Semicircles can be drawn with an ink compass if available, or can be drawn with a school-type pencil compass and then filled in carefully by hand with a mapping or other fine pen. The writer has used this latter method with quite good results although an ink compass is the more satisfactory method.

"The same drawing equipment can be used to draw up cardboard dial scales, which can then be attached to the cabinet. Variations of humidity will cause the card to stretch tight or buckle and for this reason it should be glued securely to the panel and covered with a piece of perspex or similar material. The finished product will be something you will feel proud to show to others."

A COURSE IN TELEVISIO

PART 30—SAWTOOTH OSCILLATORS (Cont.)

To avoid overloading the magazine with articles on television, this series has not appear since Apr.l last. We now resume the discussion of multivibrators, passing on later to disc also the very popular blocking oscillator.

THE concluding paragraphs in part 29 explained the operation of the conventional plate-grid coupled multivibrator, commonly described overseas as the Abrahams-Bloch circuit. Certain general points were made:

(1.) A multivibrator oscillates because the number of valve functions involved (normally two) and their interconnection provides a positive feedback loop around the circuit.

(2.) The valves in a multivibrator can be interconnected in other ways and give equivalent results, provided the regenerative character of the circuit is maintained.

NOT ESSENTIAL

(3.) Although multivibrator circuits are commonly built around twin triode valves, this is by no means essential. Entirely separate valves can be used, if necessary with quite dissimilar electrical characteristics.

(4.) The components in the respective coupling circuits can be given deliberately different time constants, so that the two valves conduct for unequal time intervals.

Figure 167 shows an alternative multivibrator circuit in which the coupling between the two valve sections is partly through a common cathode resistor. The action of the circuit is as follows:

When the application of voltages allows the valves to begin functioning, current begins to flow through the two plate resistors Rp1 and Rp2.

The rising current through Rp1, causes a voltage drop to appear across it, so that the plate potential of V1 moves from the B-plus potential toward earth. As a result, a negative-going signal is coupled through capacitor C to the grid of V2, retarding and then reversing its own natural rise in plate current.

CATHODE RESISTOR

A falling plate current in V2, counters the effect of rising plate current in V1, insofar as the voltage drop is concerned across the common cathode resistor Rk, so that the plate current rise in V1 is not hindered, as much as otherwise might be the case, by the degenerative effect of Rk.

Thus, the plate current of V1 rises rapidly, while the negative-going signal at the grid of V2 drives this valve toward and beyond cut-off.

Ultimately, of course, V1 must reach saturation, by drawing as much current as the valve and circuit conditions will allow. When this happens, the fall in V1 plate potential must halt, thereby terminating the negative-going signal which has hitherto been applied through capacitor C to the grid of V2.

What is more, the capacitor cannot sustain the negative signal on the grid of V2, which now returns to earth potential at a rate determined by the time constant of C and Rg2. Naturally, the larger either or both of these components are, the longer will it take for the grid to approach a voltage, less than cut-off, at which V2 can begin again to conduct.

When V2 does begin to conduct, its plate (or cathode) current must add to the voltage drop across Rk, increasing the effective bias on V1 and therefore tending to reduce its very high plate current.

The plate voltage of V1 will therefore rise, supplying a positive-going signal to the grid of V2 and therefore accelerating the action. It reaches the ultimate condition where the grid of V2 has been driven positive, allowing grid current to flow and charging C through Rg2. Meanwhile, the heavy plate current of V2, flowing through Rk, has cut off completely the plate current of V1.

With V1 cut off and V2 saturated, the movement in voltages must cease. The positive-going signal which has held V2 in a conducting condition disappears, leaving its grid merely at ground potential and a large positive potential across Rk. The plate current of V2, therefore falls almost instantaneously; the bias which has held V1 at cut-off disappears so that this valve begins once again to conduct.

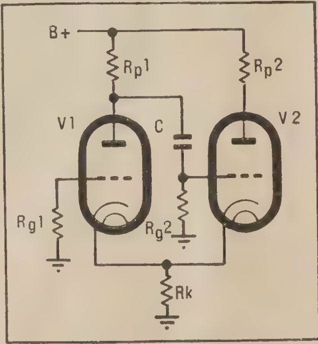


Figure 167: Here is the basic circuit of a cathode-coupled multivibrator. Important points about this circuit is that conduction periods for the two valves are unequal, while its configuration leaves one grid and one plate accessable for external connection.

The plate potential of V1 falls, therefore, applying a negative-going signal to the grid of V2, which adds to th mulated charge in C, to force the V2 highly negative. Thus V1 ru again towards saturation, whi reaches cut off and the whole c events is repeated as lib.

While the action of the circ necessarily had to be described i or less leisurely fashion, it does involve very short time interval our present purpose it may b sidered that, from the instant con begins for either valve, it reaches tion almost instantaneously.

The substantial time intervals this "switching" action are gover the time constant of the coupling nents. By selecting suitable va these components, the multivibra be designed to have a natural f ning frequency in the vicinity o 16,000 cps, as for frame and quency operation in a TV recei

While the two basic circuits t discussed are typical of most vibrators, the operation of any which may be encountered, shou to a similar process of reasoning

PLATE, GRID WAVEFORMS

The wave forms of a multivib not necessarily satisfy the basic ment for a linear sawtooth o suit the deflection amplifiers. T waveforms are basically rectan shape, while the waveform at th connected grid (or grids) is a c tion of a near-vertical transient exponential charging curve.

It is common practice, there associate one plate circuit with ternal resistance-capacitance circuit, much the same as is d gaseous or other sawtooth gene

When the plate current is cut capacitor can charge through it ated resistor towards the HT potential. When the tube sudden to conduct, it withdraws energy capacitor, discharging it to lower potential. Then the tube again, allowing the capacitor to ready for the next discharge, an

For a good sawtooth wave required in most television the particular valve controlling ditional R/C network must re off for as long as possible, so charging time will occupy p the full period between synch-p period of conduction and capa charge must likewise be as brie sible.

It follows that a symmetric is not called for since, in such the periods of conduction an for each valve are approximat In a practical multivibrator r, therefore, it is normal to de- dissimilar conduction and cut- ds.

condition occurs more or less atter of course in the cathode multivibrator shown in figure V1 cuts off and V2 begins to there follows a brief period hich C is charged from the B- via Rpl and the grid-cathode on of V2 (in parallel with

the resistive quantities are rela- all, the charging period is brief. cuts off and remains so until ge leaks away via Rg2 alone, no duction being present while the egative.

e purposes of further discussion, 68 can be regarded as a basic ator circuit, of a type often television receivers. Portion of uit is identical with figure 167.

ENCY ADJUSTMENT

and foremost, provision must for it to lock to the incom- h. pulses. A synch. input cir- t therefore be provided and a f varying the oscillator's free- frequency, so that it can be le lower than the pulse repeti- . This last is an essential pre- to correct synchronisation, as in an earlier article.

ment of the oscillator's natural y can be achieved readily by potentiometer element to vary resistance in the coupling cir- s, therefore, becomes the "hold"

f the special advantages of the coupled multivibrator is that it grid immediately available for ulse injection and also a plate discharge function.

ircuit to do with this synch. id may vary a great deal in being governed by the design ynch. separator stage, and per- olving an integrating or differen- etwork. It may also be desired the synch. pulse amplitude if onsidered excessive.

mponents in the grid circuit are shown dotted and merely in- the coupling circuit would pro- C grid return, plus attenuation, on or differentiation, as re- d.

E PULSE

lly, a positive-going pulse is re- trigger the discharge tube in ibrator. As the grid rises from negative potential towards cut- ositive pulse can carry it into luction region and initiate the cycle before it would other- our.

requently, however, as in figure h pulses can be fed more con- or effectively into the alterna- e. Since this is normally con- while the discharge valve is cut an operate as an amplifier for ning synch. pulses applying them grid of the discharge valve the normal coupling circuit.

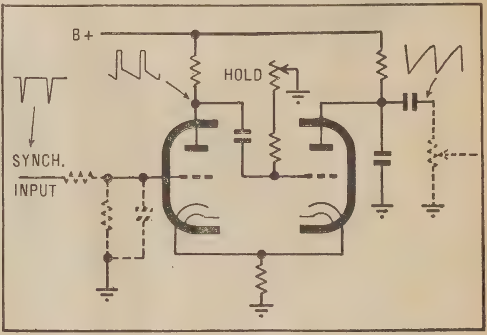
er, in passing through the extra e synch. pulses are inverted so a positive pulse at the grid of arge valve, a negative pulse is at the input grid. This means, in turn, that the synch. pulse separator stage must be designed to deliver negative output or else the pulses must pass through a separate inverter stage.

The sawtooth components are shown connected to the final plate in figure 168. They involve a resistor from B-plus to plate and a selected capacitor to earth. The resistor must be small enough to apply a useful average plate voltage to the valve, while the capacitor must be selected to give a time constant such that a suitable proportion of the charging curve will be fitted into the periods between successive discharge pulses.

☆

Figure 168: A cathode-coupled multivibrator adapted to produce sawtooth output. Voltage waveforms indicate the negative-going synch. input pulses, the long conduction periods of the first valve and the sawtooth output from the plate circuit of the second.

☆



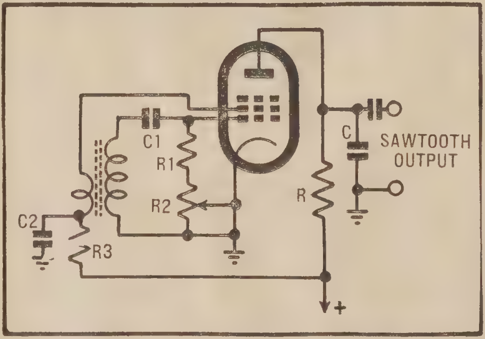


Figure 169: One form of the poular blocking oscillator, as described in the text. The blocking frequency is determined mainly by the constants in the grid circuit but the sawtooth output voltage is developed across a second R/C circuit connected to the plate. Use of a pentode and a virtual "electron coupling" effect between grid, screen and plate is not essential to the operation of the circuit.

As the value of the capacitor or resistor is reduced, the capacitor will the more nearly be fully charged between discharge pulses. The sawtooth voltage will have greater amplitude but also greater curvature. Conversely, increasing either or both R and C will reduce sawtooth amplitude but improve linearity.

If the oscillator is to operate at frame frequency (i.e. 50 cps) the sawtooth components can be pre-set to give the desired order of linearity and output, the sawtooth voltage then being fed to the deflection amplifier via a normal coupling capacitor and potentiometer. This last would then be the "Height" control.

At line frequency (15,625 cps) the high frequency losses due to this method of coupling may be regarded as excessive, making some other form of height control necessary.

A possible scheme is to replace the charging resistor, in part, with a potentiometer, so that variation of it will vary also the sawtooth amplitude. The method assumes, that the tolerances elsewhere in the circuit will be held close enough to avoid the need for wide variations in height setting, with consequent variations in linearity.

Adjustment of height or width by this method, affecting the average operating potential of one of the oscillator valves will have a second-order effect on frequency, since variation in plate potential is related to the cut-off and triggering bias level. Wide variation in the Height or Width may therefore make it necessary to reset the Hold control.

Though the discussion of the basic multi-vibrator has been kept deliberately on a general plane, the type of circuit shown in figure 168 is only used in commercial practice for the frame oscillator.

Invariably, these days, the line oscillator is associated with stabilisation and/or automatic frequency control circuits, aimed at making it less sensitive to interfering noise pulses. A little later, therefore, we shall examine the use of such circuits with a multi-vibrator.

BLOCKING OSCILLATORS

Aside from the multivibrator, a type of sawtooth generator which finds very wide current usage in television receivers is the so-called blocking oscillator.

Fundamentally, it represents another way of making a conventional hard valve draw brief, heavy bursts of current, while being held at or beyond cut-off at other times. Suitably applied, the

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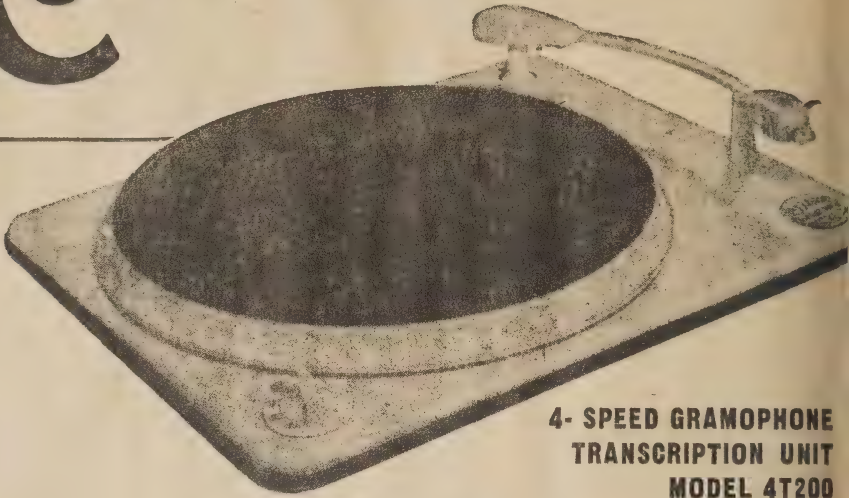

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ate states can be made to operate ge-discharge circuit, in much the way as a gaseous tube or a multi- or.

fact, a blocking oscillator bears comparison with a multivibrator, t both rely on positive feedback ee oscillation to produce periodic locking, with consequent plate cur- ut-off. The vital difference is that, as a multivibrator uses an extra to produce phase rotation and e feedback, a blocking oscillator on grid-plate coupling through a or double-wound transformer.

, in fact, an adaptation of the prin- behind "squegging" oscillators, so r in past years to constructors of broadcast and short-wave receivers.

RATE VALVES

inally, blocking oscillator type th generators involved two sep- valves, almost as a matter of . One served purely as an oscilla- ith circuit constants arranged to at a frequency capable of being to the incoming frame or line pulses.

oduced, in its plate circuit, a series rp conduction pulses, which were o trigger the grid of a second controlling a resistance-capacitance -discharge circuit, in the manner described for a multivibrator.

e recent development has allowed unctions to be combined very suc- ly in one valve, which may be a triode or a pentode, arranged ariety of ways.

re 169 shows a blocking oscillator using a pentode valve, with e-grid-screen providing the basic rative circuit and the plate con- the sawtooth components.

circuit requires that the trans- in the grid-screen circuit have ghtly coupled windings, so phased produce a regenerative or oscil- effect.

ollow the action of the circuit, let ume that the valve has been in a condition for some time and that or C has been charged through omething approaching the potential B-plus supply line.

URENT FLOWS

a particular instant, the valve to conduct, current flowing to late and screen. As far as the ory circuit is concerned, the unctions as an anode and the sud- mmencement of current through dback winding on the transformer s voltage and current in the grid g.

connections are so phased that screen current causes a positive- signal to appear on the grid. This ates the rise in screen current, further increases the amplitude of sitive grid signal, in cumulative .

positive-going signal on the grid grid current to flow. Thus, while nal voltage from the transformer ing one side of C1 in a positive n, the flow of grid current is ting the other side from rising very ove cathode or ground potential.

In other words, while regenerative is causing a rapid increase in current, a difference in voltage rge is being developed across C1, the transformer side being more positive than the grid side.

What is more, this charge can be built up very rapidly, the rate of charge being limited only by the resistance of the transformer winding and the comparatively low resistance path between cathode and grid, when the latter is conducting.

The cumulative action can only continue until the screen current reaches saturation, as determined by the valve and circuit constants. Then the rise in current through the feedback winding must halt.

Since the voltage induced across one winding of a transformer is dependent on the RATE OF CHANGE of current through the other, a flattening off in the screen current causes the positive-going signal on the grid to disappear. The transformer side of C1 therefore drops immediately toward earth potential, by reason of the low DC resistance of the transformer winding.

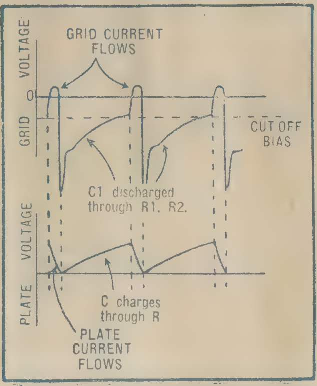

Figure 170: This diagram illustrates typical voltage wave forms in the grid and plate circuits of a blocking oscillator.

Because of the charge which has just been built up across C1, the grid is carried highly negative, cutting off all current flow through the valve. The current remains cut off until the charge in C1 has leaked away through the resistors R1 and R2, sufficient to allow the grid once again to rise above cut-off.

The moment it does rise above cut-off, the whole cycle of events repeats itself.

GRID WAVEFORM

As with a multivibrator, the voltage waveform on the blocked grid has a roughly triangular shape, being a composite of a small positive, then a negative pulse and an exponential discharge curve back toward zero. It could conceivably be used as a signal voltage to drive a deflection amplifier but the more usual practice is to develop a more precise sawtooth across a supplementary R/C network in the plate circuit.

The plate current follows the general behaviour of the screen current. When the grid is beyond cut-off, no plate current can flow. When the grid rises above cut-off or is in the positive region, it flows very readily.

As far as R and C is concerned, the action of the valve is exactly the same as with the cathode-coupled multivibrator described earlier. During periods of cut-off, C charges toward the B-plus potential through R. When the valve conducts, C is discharged, repeat cycles forming a sawtooth waveform.

Figure 170 shows the type of waveforms which result from this total action. The grid voltage rises into the positive region during the oscillatory period, then drops to a potential well below cut-off. It then rises exponentially toward zero volts once again, as C discharges through R1 and R2, leading into another positive excursion, and so on, in repetitive fashion.

PLATE SAWTOOTH

Simultaneously, the plate voltage rises and falls to produce a sawtooth wave as C charges through R and is then discharged by the valve.

The foregoing description of the blocking oscillator is essentially a very simple one and needs to be supplemented to provide a better understanding of its operation.

It is necessary also to point out that the evolution of modern single-valve blocking oscillators has involved a good deal of trial and error in the designs of the feedback transformers and, in point of fact, the practical success of the circuit depends very largely on this component.

It is generally conceded that the oscillator should ideally block after one positive half-cycle of oscillation. Damped oscillations may continue for a brief period thereafter and be superimposed on the discharge curve but their peak value should not carry the grid above cut-off again. As much is implied in figure 170.

Under these conditions, the conducttion period is not greater than about one half cycle of the natural resonance of the transformer and its associated circuitry.

BASIC DIFFERENCE

Herein lies the basic difference between the usual blocking oscillator, as found in TV practice, and the squegging oscillators of an earlier period. In these latter, blocking took place only after many complete oscillatory cycles, thereby greatly lengthening the total conduction period. This is not acceptable for TV applications.

The total period of conduction, which is normally equal to one half cycle, must not be longer than the total flyback time envisaged by the transmission standards. On the other hand, the period must not be so brief that the valve cannot effectively discharge its plate capacitor.

The transformer must, therefore, be designed with a suitable ratio and with very high effective coupling between windings, to ensure heavy feedback and high grid current during the conduction cycle.

It must have a strictly limited operating "Q" to ensure that free oscillation will not carry the grid positive more than once per blocking period. This usually involves designing for a L/C ratio and the use of external damping.

And the natural resonance of the winding, in circuit, must be within the

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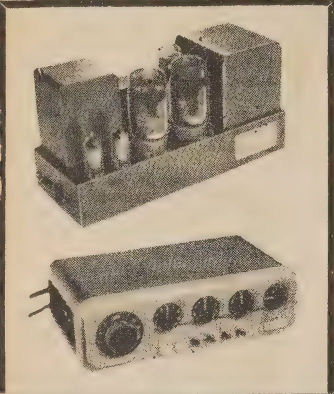

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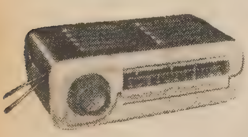

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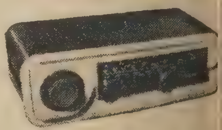

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just mentioned, which govern the tion period.

ractice, one designed for frame ncy operation is similar in appear- a small loudspeaker output trans- , being wound on a Ferrite or uality iron core. Its natural fre- of oscillation, in circuit, may be region of 1,000cps.

blocking transformers on the hand are wound more like RF rs, with honeycomb windings and n dust slug. Their resonance is to be in the 200 to 300Kc

RESISTANCE

gure 168, the blocking frequency rolled by varying the amount of ce in the blocked grid circuit, varying the discharge time. It normally need to be set to pro- a blocking frequency slightly than the synch. pulse frequency, the synch. pulses could trigger w cycle.

uency control by this method is normal for a blocking oscillator t frame frequency but, as with brators, most circuits intended for equency operation are associated me form of automatic frequency . This will be the subject of later

he output circuit, the choice of R is again a compromise between ude and linearity. If their relative are kept small, the degree of and discharge per cycle is sub- , giving high peak output voltage r linearity. Larger relative values only a small portion of the dis- curve to be included in each giving reduced output but better y.

cally, the sawtooth output voltage varied by including an adjustable ometer as part of resistor "R." tively, if frequency response is zarded, output can be controlled ing a potentiometer in conven- fashion across the output termi-

ith the multivibrator, adjustments R nd C have a second order effect king frequency, because the bias ry to produce cut-off is dependent plate voltage. Therefore some re- interlocking must be expected be- the frequency or "Hold" control e "Height" or "Width" control these affect instantaneous plate a.

DES OR PENTODES

a pentode, as shown, the inter- is minimised because the bias t-off is governed more by the potential than by the plate po- However, pentodes are not by eans essential and the majority ent designs appear to use triodes, because of their basic simplicity rtly because the triode concerned n portion of a twin valve.

synchronise a blocking oscillator, -going pulses are required, in- directly into the grid circuit.

proper synchronisation, they must at the grid just before normal is due to occur and must have nt amplitude to lift the grid well cut-off, so that conduction will ated.

nal practice is to feed the pulses in shunt with the grid circuit, an appropriate isolating resistor coupling capacitor. Provided the signal from the synch. separator is of high amplitude, the isolating resistor can be made large or the capacitor small, without reducing the pulse amplitude at the blocked grid below what is required.

In this way, the synch. input circuit has only a minor modifying effect on the time constant of the grid circuit proper.

SYNCH. SEPARATOR

Where blocking oscillators are used, therefore, it is normal to find the synch. separator arranged to provide high output positive-going pulses. Since these are normally available, anyway, from a two-stage separator-limiter, no further inversion is required and a very simple overall circuit is made possible.

In general, the locking characteristics of a well designed blocking oscillator are excellent.

In the next instalment, we plan to examine a couple more typical blocking oscillators, then show their adaption for automatic frequency control.

(To be continued.)

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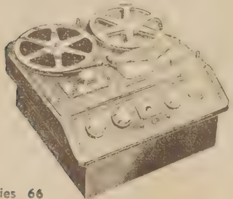

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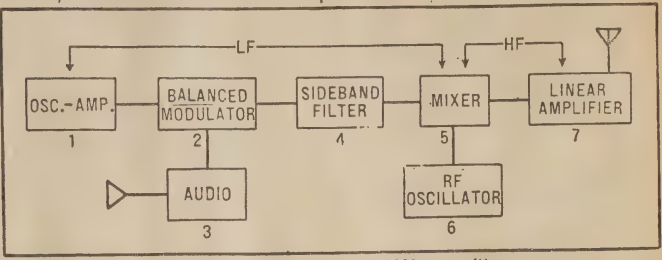
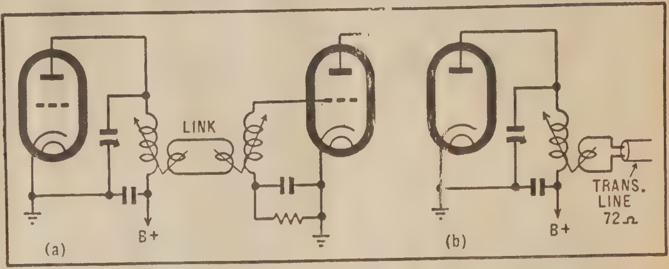
the assistance of those who are studying to gain the Amateur Operator's Certificate of ficiency, here are some answers to the technical paper set for the examination of April, 8, which we think would gain high marks. The time limit for the paper is 2½ hours, and only seven questions need be attempted.



Question 1—Block diagram of SSSB transmitter.



Question 2—Illustrating link coupling in transmitters.

ION 1:

scribe with the aid of a block am a "Single Sideband Sup-ed Carrier" transmitting system le for an amateur station. A od of reducing the carrier and nating one sideband should be y indicated.

ER:

liagram shows a standard method ning Single Sideband Suppressed transmission.

1 represents an RF oscillator necessary amplifier) to drive , the balanced modulator. The r frequency is generally between 500 Kc, depending on the type of l filter which follows. The lower cies allow filters of simpler de-

method of connecting a balanced or is to drive the grids of two valves in parallel, but to connect tput plates in push-pull. By care-ancing very little of the carrier will appear in the output circuit. odulating voltage is applied to lves in a push-pull connection, ed output will consist almost en- sidebands.

output of the modulated stage is into Block 4, a filter, which, by ing one sideband, produces a deband suppressed carrier output. s filters are normally satisfactory r frequencies, but more elaborate filters are used for higher fre-

se the carrier frequency at this ars no necessary relationship to ating frequency, it must be con- the latter by passing through a tage, Block 5, into which is in-he output of a local oscillator,

ntimes more than one conversion ace, depending on the actual fre- used and the generation of pos- sirious responses.

inal stage, Block 7, amplifies the by means of a linear amplifier, ls it to the aerial.

SION 2:

With the aid of a schematic diagram explain the theory eration of link coupling (i) en two stages of a transmitter ii) between the final stage of a nitter and the aerial transmis-line.

What is a "Faraday Screen"? e should it be employed in a nitting installation and for purpose?

ER:

nk coupling is a method of trans- energy from one inductance to ard is frequently used in trans- Each inductance has coupled to aller coil, and these coils are connected by a short length of twin cable, the whole forming the link. By these means are created two step-down transformers. The smaller coils forming the low impedance windings are usually situated near the low potential points in the circuits.

The coupling, which now exists between the two main inductances will depend on the degree of coupling to each link, and in practice this is often made a variable. It can never be as great as that which could exist between the inductances themselves because of the leakage reactance introduced by the links. The actual size of the link coils is not critical, but they should be approximately the same size. The length of the coupling line should be small in relation to the wavelength used, otherwise it must be treated as a transmission line.

The main advantages of link coupling are to provide a convenient low impedance connection between RF circuits, to allow easy variable coupling, to reduce capacitive loading between circuits, and to reduce the transmission of harmonics. The circuits may also be placed some distance from each other on separate sections of the transmitter.

i. In transmitters (Diagram A) link coupling is often used to couple the tank coil of an oscillator or amplifier/multiplier to the grid circuit of the following stage.

ii. Link coupling (Diagram B) is used to couple the aerial transmission line in such a way as to match the impedance of the line to that of the transmitter ouput circuit. Thus a 72 ohm line will use fewer turns in its link for the same degree of coupling than a 600 ohm line The link is really a low impedance secondary winding of an RF transformer. Often the reactance of the link is cancelled out by using a suitable capacitance in series with the line connection.

(b) A Faraday screen is an electrostatic shield separating coupled circuits to reduce capacitive coupling between them. In transmitters it is sometimes used between the output tank coil and the aerial coupling coil to assist in reducing harmonic radiation. It may be a number of closely spaced wires earthed at one end only. Sometimes the outer braid of co-axial cable is used for the same purpose.

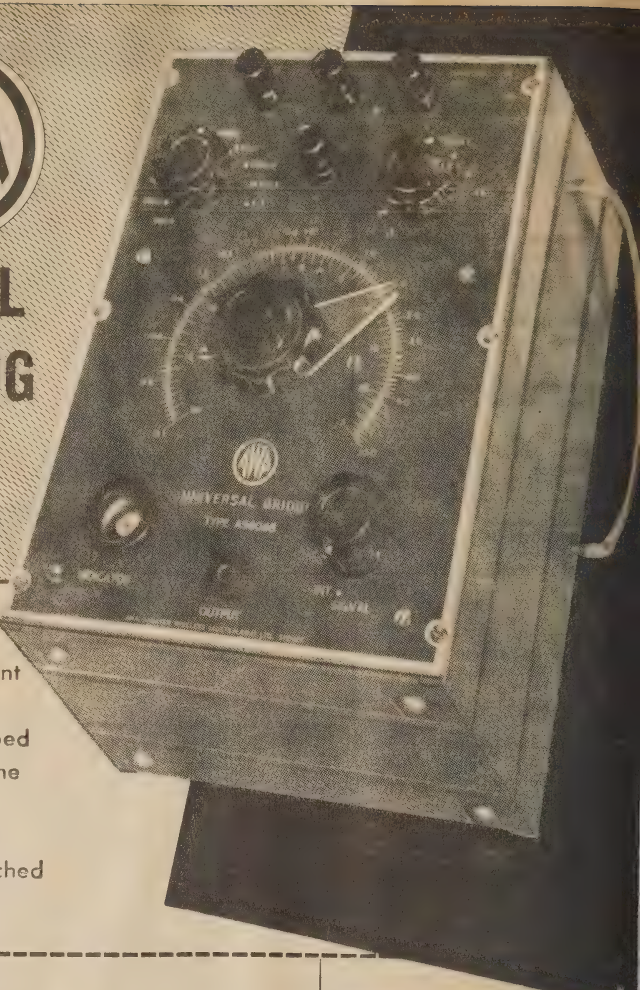
QUESTION 3:

It is desired to obtain 500 volts at 200 milliamperes for anode supply to a final transmitter stage and also 150 stabilised volts for the anode of the oscillator stage.

Draw a schematic circuit diagram showing the equipment you would use. Indicate component values and describe clearly how stabilisation of the oscillator voltage is obtained.

ANSWER:

The diagram shows a full-wave rectifier circuit to give 500 volts DC at 200 mills with a second feed point controlled by a voltage regulator tube to give 150 volts at about 30 mills. The exact voltage rating of the power transformer



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ry will depend upon the type of used, the value of C1, the re- of the filter choke, and the cur- wn from the transformer. Know- e, reference to the valve rectifier will indicate the required AC E1 and E2. With a 5R4GY, the will be approximately 500.

ransmitter use, C1 and C2 may fds each for acceptable ripple, filter choke may be anything bout 10 henries. The maximum nce of C1 will be determined naximum peak current rating of ifier, and its voltage rating by the ltage applied—approximately 500 lts. The capacitance of C2 may ased by any amount to improve and its working voltage may volts DC. The power trans- current rating must be 200 mills.

or R1 is a bleed resistor of 50k vill pass a current of 10 mills arge C1 and C2 when the power hed off.

egulator tube is a gas-filled de- id, when ignited by application cient voltage, will maintain an constant voltage drop of 150 ross its terminals, even when the flowing through it varies over range. In the circuit, R2 should llow more than the rated maxi- urrent to flow through the tube load.

. a load, such as the plate circuit oscillator, is connected, portion current flowing through the tube ed to the load. The sum of the rents remains the same in the load variations which change current from a few milliamps st its maximum rating. The re- of the regulator tube changes change in current flow through it this about.

actice the action of the regulator valuable in supplying a constant despite variations in the power voltage, due to changes in the ns supply.

VR150 provides 150 volts regu- trikes at 180 volts, and has an g current range of 5-40 mills.

uals $\frac{1,000\ (500-150)}{40}$ equals 8,750 ohms.

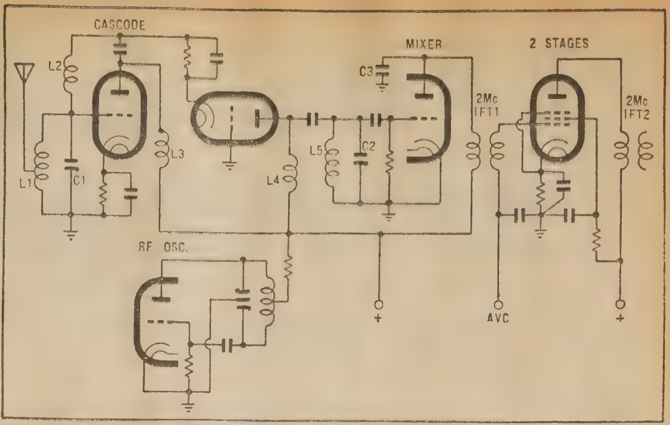
ION 4:

aw the basic circuit diagram e signal frequency amplifier, ixer-oscillator and intermediate ency amplifier sections of an nt superheterodyne receiver ception in the 144 Mc/s band. in briefly the theory of opera- of each stage.

ER:

circuit has a cascode RF amplifier a twin triode used as a mixer ned RF oscillator, followed by I stages at 2 Mc.

first section of the cascode has aerial circuit which allows good matching followed by a triode r neutralised by L2, which re- with circuit capacitances ap- tely at signal frequency. The triode is a grounded grid ampl- d produces most of the RF gain. onates with circuit capacitances l frequency. L4 is an RF choke. scode gives high gain and a low e evel. Special twin triodes are sed.

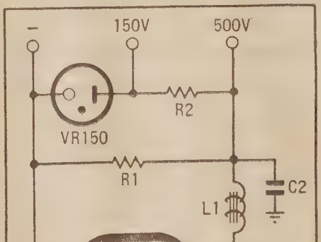


Question 4—Superhet receiver for use on 144 Mc.

RF oscillator is tunable to a frequency removed from the signal frequency by 2 Mc. Sometimes it is replaced by a crystal-controlled oscillator-multiplier if the IF stages are tunable. Injection is provided by stray coupling between the sections of a twin triode. The Colpitts oscillator circuit gives reasonable stability after warm-up.

The mixer is of the grid leak type. C3 is a bypass for signal frequencies to assist in mixer stability.

The intermediate frequency to be used depends largely upon the selectivity required. Two stages at 2 Mc give good gain and moderate selectivity, but will allow double-spotting in the band. An IF of 5 Mc will avoid this difficulty but selectivity would be worsened unless an extra stage was used. The valves would be AVC controlled by a voltage obtained from the second detector circuit. For better selectivity and freedom from double-spots a more elaborate double conversion circuit could be used, with a first IF at 5-10 Mc and a further conversion circuit to 465 Kc. Common practice is to use a crystal-controlled RF oscillator circuit feeding the mixer which is connected to a communications receiver at about 7 Mc, using it as the IF amplifier.



Question 3—Regulated power supply.

QUESTION 5:

What is meant by the terms Mutual Conductance, Plate Impedance, and Amplification Factor in relation to a thermionic valve Knowing the value of two of the above terms, how would you calculate the third?

ANSWER:

With a fixed anode supply voltage, a change in the grid voltage (E) of a valve will cause a change in plate current (I). The mutual conductance of a valve expresses this relationship I over E. The mho is the unit of mutual conductance. Frequently the micromho, one-millionth of a mho, is used to avoid very small numbers. If I equals 10 mills and E equals 2 volts, the mutual conductance equals 10 x 1,000,000 over 2 x 1,000 equals 5,000 micromhos.

The dynamic plate impedance of a valve, Rp, is the resistance of the path between the cathode and plate to the flow of alternating current. Thus a plate voltage change E will cause a plate current change I. The formula E over I gives the dynamic plate impedance. If E is 3 volts and I is 1 mill then 3 x 1,000 over 1 equals 3,000 is the dynamic plate impedance in ohms.

The amplification factor, or mu, of a valve is the ratio of change in plate voltage E1 to a change in grid voltage E2 in the opposite direction under conditions of constant plate current. The formula is E1 over E2. If E1 is 10 and E2 is 1, then the resultant is 10. the amplification factor of the valve

If the amplification factor and the plate resistance are known, the mutual conductance can be found by applying the following relationship—amplification factor over plate resistance equals mutual conductance.

QUESTION 6:

(a) Draw a schematic block diagram of a system suitable for measuring the frequency of emissions from transmitters employed in the Amateur Service high frequency bands.

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With the aid of a schematic it diagram, explain the theory peration of equipment suitable monitoring type A1 and A3 sions from a high frequency mitter.

ER:

he diagram shows a stable yne frequency meter which can gainst a crystal oscillator for a ion check, preferably operated regulated power supply. The from the meter is fed into a receiver tuned to the transmitter stion, generally set to a "net" By adjusting the meter so that out is zero-beat with the trans- carrier in the receiver, frequency ements can be read from the dial.

or Monitoring A1. In the dia- ve have an oscillating detector grid circuit tuned to the operat- uency by C1-L2. L1 is a small coil connected to a short aerial red. Oscillation is controlled by practice the grid circuit is tuned with the carrier. The resultant te is fed into a resistance capa- upled audio stage which feeds pones or loudspeaker. The unit preferably be shielded and power tered. Battery valves and supply e used.

or Monitoring A3. In the dia- crystal diode is tapped near the ential end of L to reduce circuit and C tunes the circuit to the frequency. The phones are con- to register the recovered audio e diode detector. Shielding of the desirable.

circuit for A1 could also be used etector is not allow to oscillate.

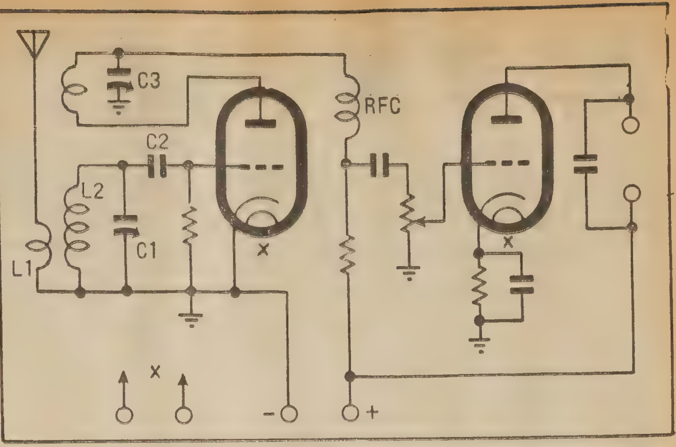
ION 7:

With the aid of a basic cir- diagram describe fully the y entailed in modulating the stage of a transmitter. Men- the effects of modulation on power and the generation of ands.

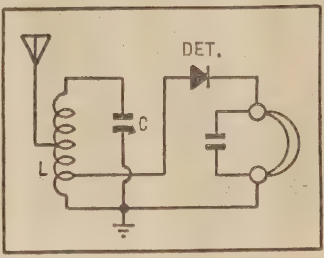
Why is a high percentage of lation desirable and what are ffects of modulation in excess 0 per cent?

ER:

n the basic diagram, V1 is a RF amplifier. Application of the grid circuit causes a nega- tential to build up at that point



Question 6b—Circuit of equipment to monitor A1 transmissions.



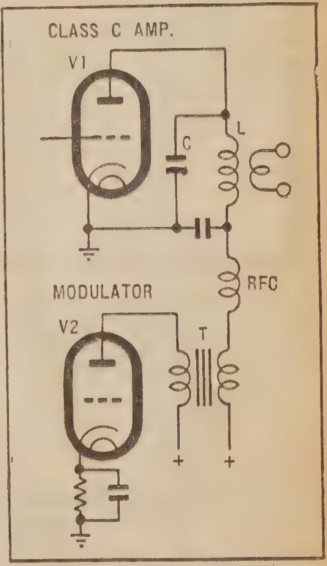
Question 6b—Circuit of a monitor for A3.

by grid rectification. The drive should be sufficient to generate at least twice the voltage required to cut off the plate current at operating plate voltage. The amplifier is loaded to its rate plate current.

Plate modulation takes place when an audio power amplifier V2 generates an AC voltage across the primary of T1 and thus across the secondary, which is connected in the plate circuit of V1.

When this applied voltage is sufficient to vary the instantaneous plate voltage of V1 between zero volts in a negative direction and twice the normal voltage in a positive direction, the RF stage is modulated 100 per cent. The plate current rises and falls in phase with the plate voltage, also between zero and twice the normal instantaneous value. In each case, the average plate voltage and current remain substantially unaltered if the stage is adjusted for perfect linearity.

When tuned to resonance, the RF amplifier presents a resistive load to the modulator, of a value to be found by dividing the plate voltage by the plate current in amps, the answer being the number of ohms. Thus 1,000 volts and 100 mills represents a resistive load of 10,000 ohms. The modulation transformer provides an impedance match between V1 and V2.



Question 7a—Illustrating modulation of a final transmitter stage.

The power required to modulate this example with sine wave input will equal 707 volts multiplied by 70.7 mills, a power of 50 watts. As the input of V1 is 100 watts, the audio power required

(Continued on Page 95)

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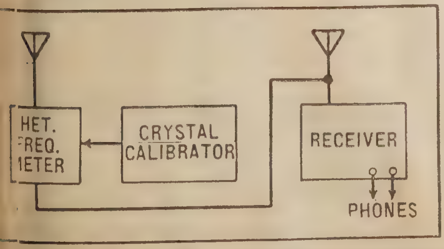

Question 6a—Set-up for measuring the frequency of an amateur transmitter.

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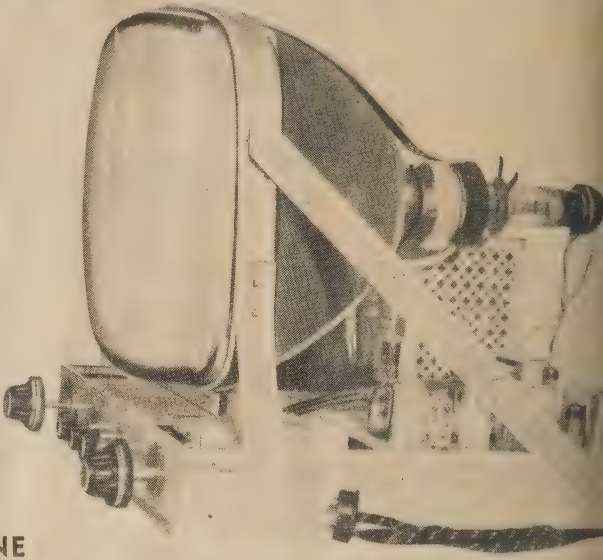

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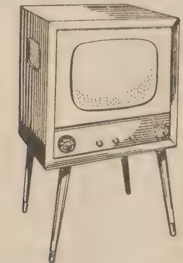

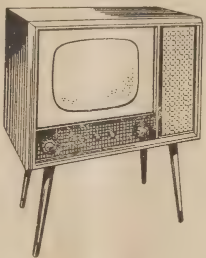

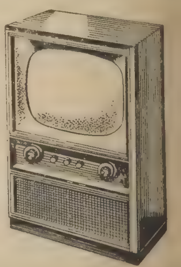

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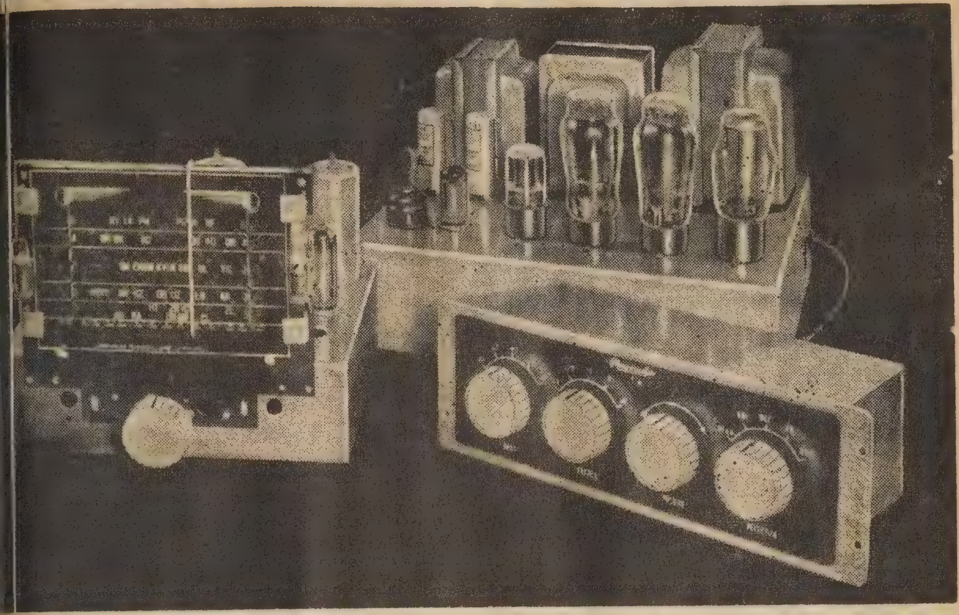

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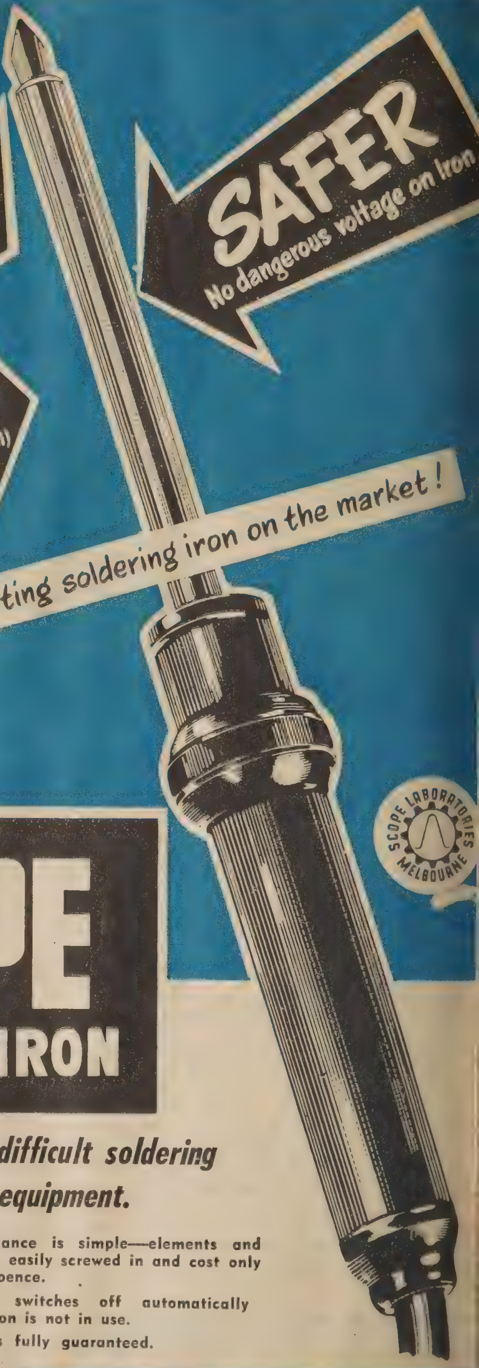
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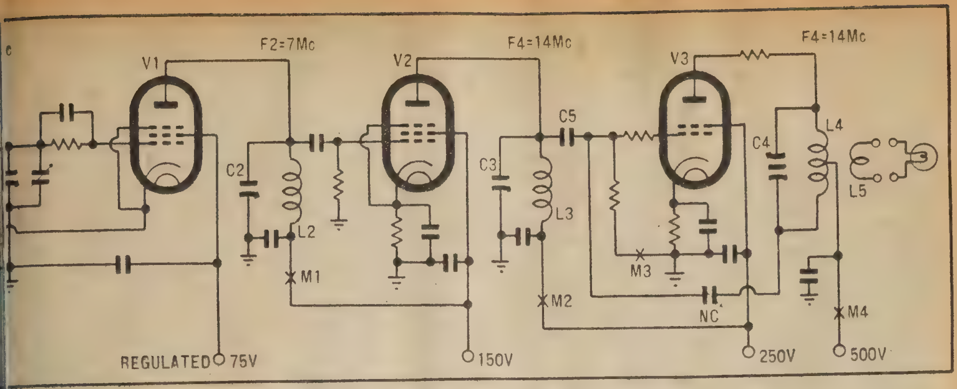


Question 9—Schematic diagram of 14 Mc amateur transmitter.

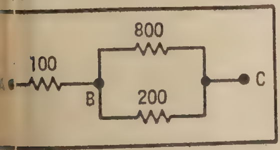
r cent of the RF input power modulate the stage.

se the instantaneous values of tage and current are varied, the eous power output of the stage sed four times on positive modu- eaks and reduced to zero on peaks for 100 per cent modula- ius the radiated aerial power will increased four times.

e additional power supplied by ulator will appear in the side- alf in the upper and half in the Of the 50 watts mentioned, each will therefore receive 25 watts r.

is desirable to use a high modu- rcentage because at the receiver ator, a higher audio voltage will ered from the carrier, and the signals will be louder. High ion is therefore economical of ter power.

dation higher than 100 per cent ise cessation of the carrier on peaks and the generation of radiations unless special precau- e taken. With such precautions, deband power can be added to er, causing a higher average level at the receiver. This is because e voltage and current can rise han for 100 per cent modula- though they cannot fall lower ro. The modulation characteris- en no longer linear.



SION 8:

A resistance of 100 ohms is con- ed in series with two resistances rallel of 800 and 200 ohms re- ely. An E.M.F. of 260 volts alied across the combination.

lculate (i) the current drawn the supply; (ii) the power dis- d in the 100 ohms resistance.

SWER:

find the resistance between B This equals 800 x 200 divided plus 200 equals 160 ohms.

The total resistance between A and C now equals 100 plus 160 ohms or 260 ohms.

(i) The current in the circuit equals E over R equals 260 over 260 or 1 amp.

(ii) The power dissipated in the 100 ohms resistor equals I squared R, or 100 watts.

QUESTION 9:

(a) With the aid of a schematic circuit diagram describe the tuning, stage by stage, of an efficient V.F.O. controlled transmitter suitable for operation within the 14 Mc/s band.

(b) Under what circumstances is neutralisation of a radio frequency amplifier necessary? Briefly explain one method of neutralising the final stage of a transmitter.

ANSWER:

(a) The diagram shows a simple transmitter using an electron-coupled oscillator operating on 3.5 Mc. With rigid construction of the coil and associated wiring, a high-C tuning circuit, and regulated screen supply, very stable frequency control is possible, particularly as the output circuit is tuned to F2. The second stage is a frequency doubler to F4 which is the operating frequency of 14 Mc. The final stage is an RF amplifier pentode with parasitic suppressors in grid and plate leads using a split stator tank circuit with neutralisation back to the grid. Voltages are typical of those used with suitable valves.

The tuning of the oscillator stage is accomplished by means of C1 which together with L1 resonates the tuning so that the fourth harmonic will cover the 14 Mc band. It is first set to a suitable frequency with no high tension voltages applied to the remainder of the transmitter. This frequency is determined by reference to a frequency meter or a monitor.

The circuit of C2 and L2 is tuned to F2, indicated by a dip in the plate current of V1 measured at M1.

The circuit of C3 and L3 is tuned to F4, as indicated by a dip in the plate current of V2 measured at M2 after plate and screen voltages are applied.

A meter is inserted at M3 to measure the grid current of V3 with a heated cathode but no high-tension voltages. The neutralising capacitor NC is adjusted so that, when C4 and L4 are resonated to F4, no sudden change in grid current is indicated. The drive to V3 is adjusted by varying the value of the coupling capacitor, C5, its point of connection to L3, or the screen voltage to V2, until rather more than the rated grid current is drawn by V3.

This procedure will indicate the approximate resonance adjustment of the final tank circuit.

The aerial coupling coil is loosely coupled to L4 and connected to a dummy load such as a light globe. The high tension for screen and plate may now be applied to C3 and the tank circuit quickly tuned to resonance as indicated by the minimum reading of the meter M4 and some illumination of the globe. It is preferable to reduce high-tension voltages during preliminary tuning of the final stage.

The coupling between L4 and L5 is adjusted so that, tuned for maximum plate current, the valve draws its rated plate current.

The amount of grid current of V3 is now adjusted to the rated amount.

Having thus proved its operation, the transmitter may be connected to the aerial and its coupling coil adjusted for the same plate current as with the dummy load.

(b) Neutralisation is necessary with a triode RF amplifier valve to balance out the grid-plate capacitance which would otherwise cause oscillation due to feedback when the grid and plate circuits are tuned to the same nominal frequency. It is not necessary if the valve is a frequency multiplier. It is also desirable with screen-grid types, if the grid-plate capacitance is enough to cause any appreciable variation in grid current when the plate circuit is tuned through resonance.

A method of adjusting the neutralising capacitor is included in the answer to the first part of this question.

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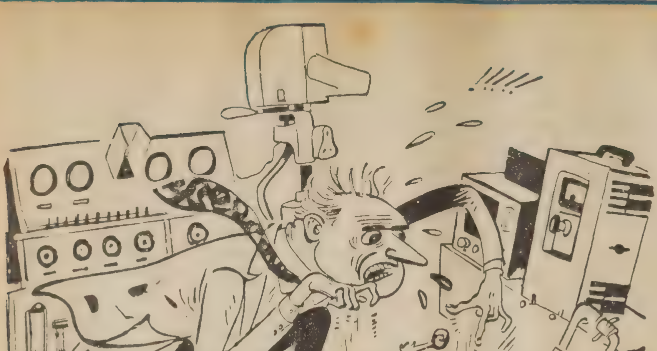

Let's Buy An Argumen

A recent A.O.C.P. examination paper provides material for two articles this month, o
elsewhere by the Editor and what follows, by yours truly. Let me hasten to say, however, th
I am not planning to pick a fight with the examiners—not a serious one, anyway.

WHAT I have in mind is something altogether different.

As we settled down over a cup of morning tea, the other day, the Editor asked in the most innocent possible way:

"How would you define a valve's plate impedance?"

In the manner of one reciting a well-known creed, I said: "If by impedance you really mean resistance, then a valve's plate resistance is the Ohmmic relationship between a small change in plate voltage and the change it produces in plate current, all other voltages remaining fixed."

"Wrong," he replied!

THERE ARE SOME THINGS . . .

Now there are some things you can say to a man and get away with. There are other things you can't say . . . and this was one of them.

It was only after about the fourth dismayed, explosive splutter that I realised he was placing my tibia under tension—pulling my leg, in other words.

But there was a purpose in so doing.

It appears that, during the previous hour or so, he had been writing specimen answers to a recent A.O.C.P. examination paper and had come across this question:

"What is meant by the terms Mutual Conductance, Plate Impedance and Amplification Factor in relation to a thermionic valve . . .?"

Wishing to phrase his answer in the accepted "Ham" manner, he had duly referred to the latest edition of "The Radio Amateur's Handbook," which is pretty much the accepted textbook for the A.O.C.P. examination. Therein he found, inter alia, the following sentence:

"This means that the resistance of the plate-cathode path—that is, the plate resistance—of the tube is high."

His point was simply this. In the face of such a sentence, could the uninitiated be blamed for assuming what the sentence seems to infer? That the plate

by Neville Williams

resistance is the resistance of the
cathode path? That its value co
calculated by dividing the applie
voltage by the current flowing an
ing the answer ohms?

It was on the strength of this
ence that he issued the aforemen
challenge to my definition.

Perhaps, in some ways, it is
to lift a sentence out of its conte
proceed to a wholesale criticism
In point of fact, when read in c
it becomes quite clear that the
is not himself under any misapp
sion; that he knows quite well w
term plate resistance or impedan
mally means.

However, when studying an unf
subject, students are all too re
grab hold of some sentence which
to be simpler than the rest and m
the foundation for their subs
thinking. On this basis, that se
which I quoted could be a very
hazardous one.

It would qualify easily for in
in the list of "Things-which-could
been-better-said. . . . Technical Se

Come to think of it, I wonde
many readers have been stumblin
this matter of plate impedance o
resistance?

The concept of finding plate resi

by dividing plate volts by plate c
just doesn't work out, of course.

Take the case of a 2A3, for exa
which under typical class A cond
draws 60 milliamps at 250 volts
would presumably give a "plate
ance" figure of just over 4,000
whereas the makers quote 800
Something's wrong, our calculation
teriously errs on the high side.

ANOTHER VALVE

Now try a 6L6, which has rather
lar ratings—250 volts at 72 milli
This would seem to represent a
resistance" figure of about 3,500
but the makers' quoted figure is 2
Our calculation errs grossly this ti
the low side.

Very obviously, some straighteni
is called for.

In the first place, the terms impe
and resistance get mixed up rather
and, if I wanted to pick an arg
with the P.M.G. examiner, I coul
gest that he has used the wrong
framing the question.

In saying this, I may be skati
rather thin ice. It is difficult to
a terse definition of either resistan
impedance or to find one in radio
books. Even our office technical d

ich is usually very reliable in tters, is not very final or fulsome ubject.

interesting to discover that all es exhibit the property of resis- at it is measured in ohms and magnitude of an ohm can be ed with the aid of a certain of mercury, etc.

rouble is that arguments about e have to be based on these at lengthy treatments, rather a single "official" definition.

ps I can start the ball rolling esting that, in normal technical he word resistance refers to a property or function which op- e flow of electric current and the current and voltage are in

LEX CIRCUIT

f the word impedance, on the nd, infers that the circuit under n contains reactance as well as e. While the properties together he flow of electric current, the and voltage in the circuit nor- fer in phase.

estion in the examination paper ly concerned with the simple s of a radio valve, both by the tandard of the paper and by the it calls, in the second part, for onship between the plate what- upposed-to-be and mutual con- and amplification factor.

asonable to expect the examinee the relationship between these and plate RESISTANCE.

IMPEDANCE would be quite matter because the term would plate voltage and current are ase, the valve presumably being der conditions where, for its internal capacitances were it. In such a case, neither its ameters nor their relationships simple.

could be no great risk, there- proceeding to and upon the n that the examiner was some- iss in framing the question and really meant plate RESIS-

NOUGH?

he term "plate resistance" itself y explicit?

it not mean equally well the f resistance connected as a load ate circuit? Or the equivalent of the D.C. conduction path plate and cathode?

pose it could, and for the very ason that we are so often con- e incomplete terms and phrases. nount of resistance connected in the plate circuit of a valve rrectly be referred to as the d resistance." If we are talk- the component rather than ity, it is the "plate load re-

aid that I'm at a loss to define possibility very well, namely ulent resistance of the DC con- ath between plate and cathode. le is that one very rarely has to nominate or calculate its

alue is implicit, of course, in fact that there is a definite d current between these two By Ohm's Law, this must be equivalent to a certain value of resistance.

But, in working out operating conditions for valves, we normally make use of the current and voltage figures only, seldom if ever having need to extract the equivalent resistance. It remains very largely, therefore, a nameless orphan.

What the examiner had in mind was obviously neither of these, but the one which should ideally be referred to as the "dynamic plate resistance." This is the property which is very frequently referred to in working out valve circuits and which can be related readily to mutual conductance and amplification factor.

The adjective "dynamic" is quite significant, because it indicates that the property is one involving an operative or "signal" condition, rather than a static one.

According to valve literature, the dynamic plate resistance of a radio valve is, and I quote:

" . . . . the resistance of the path between cathode and plate to the flow of alternating current. It is the quotient of a small change in plate voltage by the corresponding change in plate current and is expressed in ohms, the unit of resistance.

"Thus, if a change of 0.1 milliampere (0.0001 ampere) is produced by a plate voltage variation of one volt, the plate resistance is 1 divided by 0.0001, or 10,000 ohms."

THE FULL TERM?

Perhaps we should proceed to the logical conclusion and suggest that the examiner should have used the full term "dynamic plate resistance" in setting the question, but we might easily find ourselves in the position of the pot which is allegedly given to calling the kettle black. The chances are that we have used the unqualified term "plate resistance" many times ourselves.

The point is that viewing the plate circuit of a valve as a resistor is so rare that it is scarcely necessary to enforce any distinction. Therefore the word "dynamic" becomes somewhat redundant and is omitted about as frequently as it is included.

But plate impedance? No, that's stretching terminology a little too far for comfort.

THEY DID IT FIRST IN THE SOVIET

Dear Editor,

In the course of my job, I became interested in antenna theory and that led me to dip into the Soviet popular literature for radio amateurs (You see, I speak Russian better than I do English).

Now I find that The Anthology of Readings in Radio and TV for Radio Amateurs, compiled by T. O. Spizhersky and V. A. Burlyand (Moscow-Leningrad; State Energetics Publishing House, 1957: 2nd Edition, Radio Library for the Masses, Vol. 283) puts up the following Soviet First-In-The-World claims, ignoring Edison, Marconi, Braun, Nipkow and all the rest completely.

1889: A. S. Popov lectured on the possibility of using E.M. waves for wireless communication.

1895: May 7. A. S. Popov lectured and demonstrated his first in the world radio receiver. (May 7 is "Radio Day" now in Russia).

1896: March 24. A. S. Popov transmits the first in the world radiogram over 250 metres.

1897: Summer. A. S. Popov, with associates communicates by wireless over 5 kilometres.

1899: Spring. P. H. Ribkin and D. S. Troitsky discover the reception of radio signals through a telephone receiver.

INCREASING RANGE

1899: Autumn. A. S. Popov establishes radio communication over 20 kilometres.

1900: January. A. S. Popov communicates by radio over 40 kilometres.

1901: Autumn. Two-way radio communication over 150KM.. the first practical wireless communication at sea, the first transferable army wireless stations.

1911: May 9. B. L. Rosing operating model of TV, first in the world with simplest picture on the electron tube screen.

1915: V. T. Kovalenkov, first in the world with two-way telephonic transmission with a valve amplifier.

1920: M. V. Shuleykin: The first foundation of the theory of radio wave refraction in the ionosphere.

1922: B. A. Vedensky and A. T. Danilevsky; the first radio telegraphic transmission on 3.8 metres.

1927: 40 kilowatt wireless sender in Moscow with the new electronic valve generator of 25KW power rating, with water cooling of anode, constructed by M. A. Bonch-Bruyenitch. This was allegedly taken over by overseas manufacturers.

500KW TRANSMITTER

1933: The first in the world 500KW sender "Komintern."

1938: The first in the world shortwave 120KW sender for radio communication.

1932: A. N. Stitchukin; first method of calculating field tension on short waves.

1932: New principle of transmitting TV tubes by A. S. Katayer and other Soviet scientists, leading to the creation of the super-emitron.

1930: First operating model of the secondary electron multiplier (for higher sensitivity of TV transmitting tubes) L. A. Kubetsky.

1938: G. V. Braude suggested the electronic system, exploited in the construction of the super orthicon.

No date given: Magnetron; first suggested by M. A. Bonch-Bruyevitch, a resonator for VHF oscillations.

No date given: Photoelement first made by A. G. Stoletov in the 19th century.

Now, if you haven't done it before, please feature a short historical survey of radio and TV developments in the western world, confirming or refuting the above Soviet claims.

Yours sincerely, G. S.

Dual

— INTRODUCING —

1004-T12 AUTO-PLAYER

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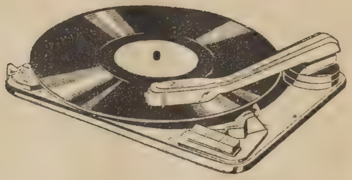

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This new model enhances the array of DUAL players, eliminating all possibility of damage to your valuable records and styli. With perfect sound reproduction, dependability, simplicity of operation and modern styling, the 1004-T12 is the answer to numerous requests for a high quality automatic player.

- **Simple Operation:** Three Push Buttons for complete versatile control. (Stop, Start, Repeat.)
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You'll need a

panel on the preceding page, eproduced a letter from a read- is apparently of European ex- As you will note, the burden that the Soviet give credit to ntists for developments which only attribute to pioneers from ntries.

ot guarantee the spelling or accuracy of every detail be- the hazards of transcription Russian textbook into English thence via my typewriter to arged with printing all this. the general sense of it is clear

reading, I was inclined to put aside as of rather limited in- ter all, first-to-do-it claims are neans peculiar to the Soviet. the most blatant publicity line has issued, within recent m the French printing presses. ither gained the impression, ing some of the literature, that nportant people in the world nch—because they had been for all the important in-

T CONVINCING

that was what the reader was o gather!

tends to smile tolerantly at n because they seem to be lk and anyhow, politically, newhere between our side of and the middle.

the others? As Joe Palooka ry eloquently, "Hmmph!"

trouble is that it is so diffi- know whether first-to-do-it well founded or not. They uite genuine, or exaggerations abrication. To discover which olve enough time, resource, d interest to delve deeply into ular country's own technical

of genuine textbooks are nat- st familiar with literature in language, with the result that point of what has transpired tends naturally to the paro-

is half done, therefore, for o wishes to catalogue develop- publicity or propaganda pur- l a few gaps, put in a few and add a dash of political nd you have a document oves" the national resource-

ARD TO FILL

may not be very hard to fill I imagine that, if one were diligently enough through s of proceedings of learned almost any advanced country possible to unearth numerous speculations, tentative ideas, h seemingly anticipate their sewhere.

ecomes very easy to say that vas first put forward by so- such and such a date and copied and developed by the us Mr Somebody-Else. The Ir Somebody-Else may never the said reference or may lf thought of it years before- t apparent. Neither is the fact aid Mr So-and-so may not the vaguest notion of how to his suggestion or prophecy.

HEAVY OF HEART — BUT STILL HAPPY

It is with the heavy heart of public rejection that I write these lines.

It would seem I am either 20 years too late or too early with most of my ideas, probably the former, but one can do nothing about the era into which one is thrust.

Down to tin tacks. Re divided load amplifiers. Many of my views have been given previously, so no punches pulled.

Radiotron Designer's Handbook, Quote: "It is possible and practicable to wind coils of a ratio of primary inductance to leakage inductance better than 200,000 to 1, whereas conventional transformers do not nearly reach the minimum requirement (for low distortion) of 80,000 to 1. This type of transformer is cheaper to wind than a sectionalized winding as used in conventional high quality transformers." P.594.

I don't for one minute agree with you when you say a new or different approach to the output stage is a waste of time because of so many recent developments (such as Ultra Linear).

As you will agree, so many things happen between the driver stages and loudspeaker that even instrument tests show very little of the true picture. Even in these modern days we still can't say why triodes are so much better than pentodes on a listening test, even with the distortion adjusted for the same in each case. But they are! Why? My theory is that as yet we don't understand which types of distortion affect the ear more actively than others.

Over the past 6 or 7 years, I've built most of your amplifiers, also, as close as possible, copies of the Leak TL12. and Quad 11, with control units down to the last detail, including the Quad control panel, physical shape, and wiring layout.

The latter is the finest amplifier I have ever listened to. My ears are very critical and I believe I can hear more than most, 21Kcs (Melb. University). I tell this to discourage any thought of psychological delusion on my part as such is not the case.

An UL output stage was substituted for the DL system adjusted for optimum conditions, and the DL transformer hooked up to switches and wires for a fast changeover. The difference was noticeable but not enough for the untechnical members of the household to grasp, which isn't surprising as they can't even tune a radio. I had no way of measuring distortion, but frequency response was almost the same.

The difference however was there, and I heard it, cleaner, crisper, and all round more alive. This is my amplifier for keeps.

Just in closing, your amplifiers don't have enough stability margin for my liking. My amp. has 26-db db and I can't drive it unstable, and I've really tried.

Yours Faithfully, D.F.

Picafarad or Picofarad?

Re your bordered query, page 87, May issue, my guess for what it's worth is that Picafarad is a product of a natural characteristic of readers. We tend, or I do anyway, to convert in our minds the printed word to the spoken word. Pic-o-farad is an awkward word to say, while pic-a-farad slips off the tongue easily. It is all of a piece with the common pronunciation of arc-tic as ar-tic, man-u-facture as man-a-facture, and ed-u-cation as ed-e-cation. Its derivation may be (the prefix pico I mean) from the Italian word piccolo, meaning small; hence a small farad.

Referring back to my second sentence, I usually do a mental stumble over such phrases in print as "a R.F. current" and "a F.M. tuner". I read these phrases as they are printed, not in full as "a radio frequency current" and "a frequency modulation tuner". Just try to say "a ar eff" and " a eff em".

(R.K. Qld.)

A fertile imagination is one thing. The patience and ability and resource to develop ideas to a practical conclusion is quite another.

Anyhow, there's the letter, if you want to support or comment or criticise. Right now, I can't see us having much time to draw up our own catalogue of what-we-did-first claims.

Then there's the letter on this page from D. F. who is still doggedly carrying the torch for divided-load amplifiers. Apparently he imagines that we're actively opposed to them, simply because we have not described an amplifier for home construction, using the principle.

If we were to be judged on our likes and dislikes by our omissions, the result would not be very flattering. As we have said on other occasions, there are many principles and ideas which we have not been able to exploit, partly through lack of time and partly because so many of these ideas involve manufacturers in releasing and stocking additional components.

Did we really say that a new and different approach to the output stage is a waste of time because of recent developments? I don't remember, but then we say so many things.

When I showed D. F's letter to the Editor, his face lit up with a most disarming smile.

"At last," he said, "a happy hi-fi reader."

"Tell him that, if the amplifier gives him so much pleasure, never to let it out of his sight."

"But I'm sticking to my 17-watt Playmaster!"

ABOUT STABILITY

As for the closing remark about stability margin, there is a lot more to this than D. F. may himself realise.

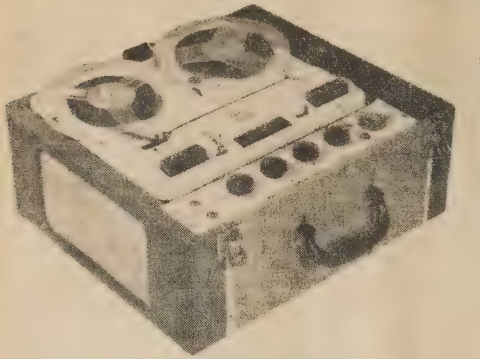
Stability is a most important factor in amplifier design and one which it is not easy to resolve.

Many amplifiers are quite stable into a resistive load but become borderline

(Continued on Page 127)

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating new Collaro Mark IV Transcription deck. The only deck with these features.



THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE PLASTIC COVERED CASE COMPLETE WITH ACOS MICROPHONE

The six-valve amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12.0 at 7½ inches per second. Azimuth adjustments on both imp "record" and "playback" heads. Output of heads is approx 5 milli-volts at 1 Kc at 7½ inches per second
- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the Fast rewind in either direction
- **CONSTANT TAPE TENSION**
  A special Collaro device ensures a constant tension on the the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
  No solenoids are used in the construction of this Transcript braking is entirely mechanical
- **FINISH**
  Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
  3¾, 7½ and 15 inches per second
- **FOUR HEADS**
  Two "Record/Play-back" and two "Erase" heads are sited different levels and head wear thus halves for any given le track.
- **TWIN TRACK OPERATION**
  One pair of heads for each track. Both top and bottom tra be recorded or played back without removing tape.
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape p "Record/Playback" and "Erase" heads and applying the br the spools while leaving all switches and mechanical func their selected positions. Typical application is to pause wh cording to omit speech interposed between musical selection trol will only work whilst it is held in position
- **TAPE MEASURING & CALIBRATING DEVICE**
  The three digit counter makes the location of any recorded the simplest of operations
- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel sh ning on a ball at the bottom of long bearing reduces frict virtually eliminates "wow" and flutter at less than 0.15 to cent
- **TWO MOTORS**
  Each dynamically balanced motor does only one job at Motors never act against each other and are of low wattag with consequent reduction in heat and wear.

COMPLETE RECORDER WITH MIKE—80 GNS. f.

DECK WITH AMPLIFIER, POWER SUPPLY and 6in x 9in SPEAKER, 70 GNS.

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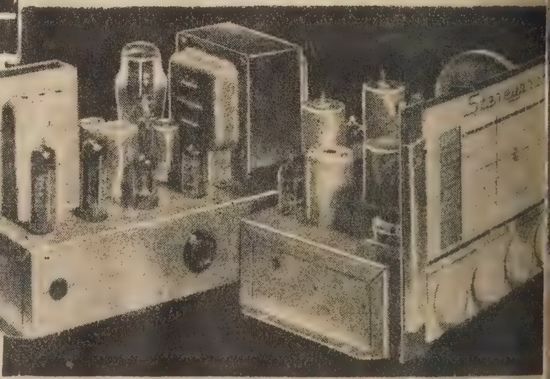
A compact 11-Valve High-grade Radiogram in two chassis featuring a variable band-width Tuner, multi-input preamplifier and Tone Control in one unit and a 10-Watt Ultra-linear Amplifier. Ideally suited for use with High-grade pick-ups and speakers.

65 GNS.

F.O.R.



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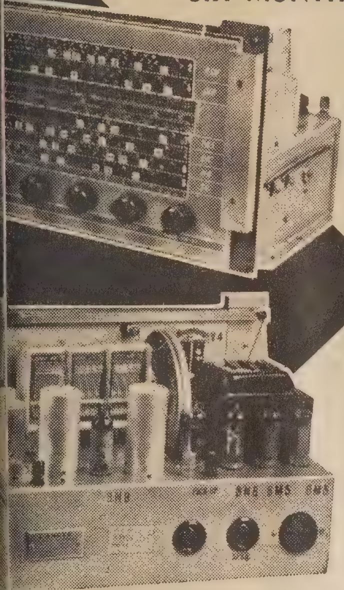

NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short wave range of 12,000 miles. All valves used are the new Mullard nine pin Innoval series.

NEW:

Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or minus 15 db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings

NEW:

Dual Speaker combination, using a heavy duty woofer (12in M.S.P. Jensen AU54 special) with matching 6in tweeter and cross-over network giving a frequency response of 46 to 13,000 cycles. Speakers are mounted coaxially making only one 11in mounting hole necessary

NEW:

If required the new Magnavox high-fidelity twin coned speaker can be supplied. Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Indicator lights are fitted showing which band is in operation. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo motor.
Power switch is fitted to volume control, radiogram switch, combined with wave change switch. Audio end of set can be used with TV receiver if required.

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT. Frequency response 40-13,000 cycles Max output 10 watts.

£41/15/0

F.O.R.

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications are nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands

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W SEVEN-VALVE HI-FI CHASSIS

ompact dual wave seven-valve chassis uses
ner circuit as our 9-valve unit with the Mul-
ntrol circuit giving separate bass and treble
sh-pull output using two of the new 6BM8
se output valves and heavy duty M.S.P.

£1/15/- F.O.R. PACKING 10/ EXTRA

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ALL 4 SPEED RECORD CHANGERS AND PLAYERS STOCKED

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OFF THE RECORD — NEWS & REVIEW

The first stereo records produced in any quantity are expected to arrive in Australia sc time in October. They will come from England and will be part of the first releases by major record firms there, such as Decca and the EMI group. In the interim it is almost cer that we will also have some locally pressed discs from companies not in a position to imp

by John Moyle

THAT is the picture as it appears at the time of writing. The bulk of the release to be made during August in England may have already been pressed, and distribution to dealers is probably under way.

Some of these records will make up Australian shipments, and I confidently expect that samples of them all will be available here.

These will, I expect, include test and demonstration discs, which will be extremely valuable. Played through a careful controlled set-up, they are the most striking examples of what stereo is and what it can do.

Frequently demonstration records contain a well-written sales commentary, much more enlightening than that which can be expected from the average salesman.

It is only to be expected that customers will want to know how the stereo record works as a preliminary to understanding why dual equipment is needed. They will also need some guidance about how to listen if their first impressions of stereo are to be satisfactory in the short time generally available for demonstrations.

I have been very much impressed by the fact that so many people who will be keenly concerned with stereo, and are even expected to make decisions about it, still do not really know how it works, what it can do, and what it can't do.

STEREO AND BINAURAL

I still hear them use the word 'binaural,' as synonymous with "stereo," for instance, without being aware that there even could be a difference.

Thus, anything in the way of information, instruction and good recordings will help smooth the path all must follow if the best is to be made of stereo, likely to hold the biggest sales potential the recording industry has known.

Not all would agree with this statement, but many do. One of them is Bill Stocklin, editor of Radio and TV News of America, perhaps the largest selling electronics magazine in the world. He says in his leader for August:—

"Stereo, stereo, stereo! No matter where we turn or where we go 'stereo' seems to be the main topic of conversation with everyone we meet in the industry. In fact, even the recent Electronics Parts Show in Chicago, which in the past was more for the radio and TV parts manufacturer, turned into a high-fidelity show with stereo uppermost in everyone's mind. The stereo disc, which was announced just a short time ago, is setting the stage for one of the greatest boom periods that the industry has ever seen or, from where we sit, will see for a long time to come. The period directly following the announcement of the LP discs some ten years ago saw a marketing boom which was tremendous at the time, but may seem insignificant when compared to the period now in prospect."

In Australia, the growth of stereo may not be as swift as it appears to be overseas for a number of reasons.

One is that both financially and "programwise," we are still in the initial period of building a TV industry. A large number of people, estimated as being about 500,000 set owners by the end of the year, and growing every month, is pre-occupied with TV and has spend or mortgaged a goodly sum to get it.

CAMPAIGN AHEAD

This money and time is not available for diversion elsewhere, and it was largely to supply a worthy competitor for both overseas that stereo has been launched.

Thus the record playing industry, both record and equipment makers, have a vigorous campaign ahead with the sure knowledge that they have a honey of an idea to sell.

But sell it they must.

America is an ideal country for a thing like stereo to grow. This excerpt from a Chicago newspaper is typical of the comment which appears almost every day. It is headed "Stereo Battle Won Without A Shot Fired." — "The stereo battle has been won and the first shot hasn't even been fired."

That is the sage observation of Morris S. Price, sales veepee for Mercury, after three days of quiet and somewhat amazed snooping at the N.A.M.M. Convention.

"I have never seen such enthusiasm for anything since the LP came out. Distributors who never show up at anything were here smiling from ear to ear. But the funny thing is none of them really know the first thing about how stereo works, and they're not bothering to ask questions to find out. In a way this is bad, because there's a big education job to do, and if these guys are going to be educators, they've got to learn first themselves.

"But in a way, it's good, too. The enthusiasm means that they are pre-sold. Distributors, dealers and consumers, they are all saying, 'Okay, I'll buy it. Now what the hell is it?'"

And while quoting some of these overseas reports, it is interesting to add a few more on various aspects of the t and selling problem. It is cl there are still some points upo different opinions exist.

This one, again from Chicag lights the need for dealer educat

"The need for all levels of the to educate themselves about emerged from a phono record d clinic at the NAMM parley. mentary nature of questions ra dealers, distribs, trade press a manufacturers—and which nobo ed expert enough to answer—se portend a possible bottleneck sumer sales merely because the men won't be ready to answer asked by the public.

Among the questions raised were almost answered but nc were those of how to spot phon just what compatability means. to separate speakers, whether or should be angled toward eac whether a monaural needle will a stereodisk, and whether man cords will continue to sell.

VALUE OF GIMMICKS

One member of a four-ma Sidney Frey, prexy of Audio-Fid cords, pioneer in stereo, suggested early buyer of stereo is the " head," the same fellow who has up everything new in hi-fi. T Frey said, is more responsive that show what his set can do he is to other aesthetic conside

"The ping pong ball and tl choo train are going to clinch m than the best symphonic rec Frey aserted.

Because Audio-Fidelity is a signed for audiophiles, Frey stereo sales have run higher dustry average. In the past fe he revealed, stereo has comp per cent of his volume. He cautiously that 25 per cent r come the industry average by tl the year.

MONAURAL TO CONTIN

Inventories of monaural recc argued flately, will never beco lete. Three reasons he offered

(1) It will take years for di build full catalogues of stereo-

(2) Many of the great artist fore stereo recording began. is a case in point. Demand immortal artists will continue

(3) A stereo playback does lete the standard L.P., but inste it sound better.

So confident is he about t of the L.P., that Frey said he ed his distribs not to overloa with stereo, but to sell on o

Frey charged that the indu confused about the word "co Somewhere along the line, he ype of stereodisc, the one now ndustry acceptance, came to be ncompatible." Actually, this ut because it is deemed inad- play a stereodisc with a needle.

rgued that the disc can truly "compatible" because it can be rough a monaural system so is tracked by a Westrex type ridge. These are now available cost. Furthermore, this cart- erfectly suitable for tracking L.P.s (But U.S.A. is using a lus. — Editor.)

nt of stereo speakers was an- ect that revealed considerable in search of a standard view- ost literature suggests place- peakers six to 10 feet apart, vard toward the listener, who the apex of a triangle.

PLACEMENT

Freas, Billboard equipment anel member, pointed out that of the triangle" theory might for optimum results, but was ary for good practical results. the speakers should not be ard, but should face forward rallel lines. Also they should more than six feet apart if the size of the room easily it. These steps, he said, tend the area in which optimum enjoyed.

error to think, Freas said, that to get maximum results to o. Frequently a listener is in om, he said, and senses the depth from a stereodisc, when he sounds of the two speakers rrectly separated for him.

Lieberson, president of Columbia Records, is some interesting comment. in introducing Columbia's o line, last week, stated that ional program" is needed to he issues and problems that ed up since the stereo splurge al months ago. "Stereo," he greatest obfuscation since the

F R EDUCATION

usion, he points out, is pri- the consumer level, but even cturers are hard-pressed to net results of a stereo market not yet been exposed to the owever, Lieberson asserts, it's cturer's job to "educate" the And the first lesson, according rez, should be that all records ed on stereo phonographs.

he made an analogy to the Lieberson doesn't foresee any een stereo and the 10-year- al LP. "Stereo," he points out, revolutionary a step as the of the LP to supersede the tressed that stereo is just a f the LP.

immicked Stereophony'

und values of stereo, Lieber- out that it is a special kind . "The only kind of stereo- is easily recognisable," he nmicked stereophony." In the category he put such stereo showcase sounds from bowl- railroad stations, auto races, ight musical discs, Lieberson the "separation of sound," which stereo offers, is the most pleasant way of listening. "We're now in an area of taste," he says, "and we won't know its effect until it's exposed to the public."

Although Columbia is introducing a stereophonic phono line and has geared itself for stereo disc releases, he doesn't foresee the obsolescence of the monaural LP and he can't predict the sales potential of the stereo disc in its first year.

"Stereo will probably account for a small percentage of the total disc industry sales volume this year," he says. He bases this figuring on the fact that there are now an estimated 27,000,000 phonographs in the U.S. which bring in a $375,000,000 disc sales volume. If phono-purchasing remains at 5,000,000 new units a year, and the new units bought are all stereo, it still will only make a small dent in the total disc sale picture."

In the meantime I have managed to collect a few more overseas discs, and my impression of their general quality is unaltered. Some are superbly good, others have faults, most common of which seems to affect the top end. But I would rather wait until more representative records and playing equipment is available before attempting to assess the results too closely.

I have also had the opportunity to use a stereo cartridge with a well-known make of record-changer, and results are good enough to indicate that there are no insuperable problems.

Incidentally, I notice that the first complete stereo opera to appear in America is expected to be Cherubini's Medea on the Mercury label.

It was made at La Scala under actual performance conditions, which might be more successful in stereo than otherwise.

Callas should be ideally suited to this role, and if past experience is a guide, there should be no doubt as to the star of the piece.

* * *

THIS MONTH'S RECORDS

ELENA NIKOLAIDI RECITAL —Excerpts from Verdi (Don Carlos and Macbeth), and Rossini (Semiramide); Songs by Mozart, Haydn, Schubert, Schumann and Brahms. With the Columbia Symphony Orchestra and Jan Behr, piano. Coronet KLC 001.

The first notes stamp this as first-class. It has all those things to make an outstandingly good disc.

The voice is natural for recording—rich, full, and vital. My only criticism is a slight tendency to sharpen pitch in the upper middle register, but it is almost imperceptible.

Her quality, too, is even and consistent throughout, and with such a wide range of pitch and voice control, this is indeed a virtue.

The orchestral accompaniment on the first side is excellent. It has good body, it is always heard, but never unduly prominent.

Both are extremely effective in the bravura passages in the Rossini arias.

The recording voice is even better on the second side, when the piano takes over from the orchestra. It is naturally more forward, and displays splendid diction.

The surfacing on this side particularly is virtually perfect. At normal room volume I could not hear it. This side, too, deals with better-known music. The Erlkonig is dramatic and well sustained, but it is hard for a female voice to handle the contrasts as well as that of a male singer. The Schumann hasn't quite enough relaxation and repose, but on the whole she copes well with the wide variety which the program presents. Very good quality.

* * *

TIME ON MY HANDS.—Twelve famous popular melodies featuring Charles White, piano, Jack Westmore, guitar, Graham Morgan, drums and bongos, Les Tasker, vibraphones and drums, Jimmy Allan, flute and bass clarinet, Neill Yoeman, bass, and Beryl White, maracas. World Record Club.

This is a locally made disc, the first of its kind produced for the World Record Club, and it is commendably successful.

The general effect of the sound, a composite impression of realism, balance and surface noise, is surprisingly good. I could be super-critical and, by comparison with the best overseas recordings of small bands, say that a more sophisticated miking would have brought improvements. More subtlety with levels, for instance, would have produced better balance without losing the clean registration of instruments which is so attractive.

* * *

TCHAIKOWSKY — Symphony No. 4 in F minor Opus 36, played by the Boston Symphony Orchestra conducted by Charles Munch. RCA L16126.

There is a large number of Fourths in the recording lists and a new one would have to be really good to come near the top.

There are also great dangers in this symphony if it is to avoid anticlimax, bathos, or just plain noisiness.

The long first movement is so filled

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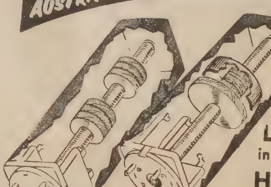

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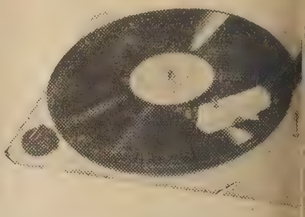

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the full shape can be lost
ing each annexe.

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viewpoint, for there are
manage these matters more

grad performance for DGG
nding example.
st, Munch's range of expres-
ed.

e the more so because the
nplitude is quite low, al-
ble grooving is not used on
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ce noise is allowed to in-
too noticeably in the quiet

hasn't quite enough air to
ull weight—most important
hony. Nor did I think the
balance always good—the
the first movement for in-

othing wrong with the or-
, technically, is one of the

usic is nothing if not an
oliday, and somehow I
appropriately excited about

t goes into the best compe-
he leaders.

* * *

T — Concerto No 3 in
for violin and orchestra
ed by Christian Ferras
Stuttgart Chamber
onducted by Karl Mun-
ecca LW 5272.

tone is a bit thin but Ferras
usic very lightly and gently.
marily the cause. After all,
nd thin if played that way.
s I thought it sounded
MI curve which softened

is close so that the solo-
with great clarity—a good
there is always sincere
playing. Much of the con-
lies in due appreciation of
and artless invention, and
done if it isn't heard.
the Stuttgart players show
be an extremely competent
music. This isn't one of
est works, but it is one of
ble, and that's exactly the
ets here.
alance is just right. I liked
ass comes through — not
to be prominent, but just
h to give a sure, firm base

d disc.

* * *

— Concerto for Violin
tra Opus 35A; Sonata
minor for Violin and
36A. Played by Joseph
the Little Orchestra
nducted by Thomas
and with Mieczyslaw
Piano. Coronet KLC

nt that Szigeti is anxious
ute to the famous pianist
who, although a much
s a friend of his youthful

ecause there isn't a great
music above the average standard of the late 19th century.

It probably is free from "ornate heaviness of the late romantics, Mahler, Bruckner, etc." as the cover notes state, but replaces it with a style strongly reminiscent of other composers of the day — Wieniawsky, Delius and even Mendelssohn.

The violin concerto as a result is quite easy to hear, but contains nothing to fix it very firmly in mind.

As part of the story of the times, no doubt there is good reason to add it to the record.

As I haven't heard it before — I doubt whether many people have — I must accept Szigeti's version as authentic, and indeed it places few demands on the executants who are generally equal to them.

The recording on this side is very good.

The sonata is a more sophisticated work in which the violinist has some difficult passages and displays fine tone in the lower strings — plus some audible breathing.

Of the two, this is the one I would feel inclined to play most often.

Technically it is good, too, with an excellent surface.

* * *

RICHARD STRAUSS—A Hero's Life Opus 40. Played by the Saxon State Orchestra, Dresden, conducted by Karl Bohm. DGG LPM 18375

The jacket notes suggest that the hero is Strauss himself and quotes a remark of the composer that he would like to compose an autobiographical symphony in support of this.

I would say that anyone who delights in Strauss's unique orchestral colours and typical mixture of vigor and sentiment would find no quarrel with either the music or the ideas.

Most of the stuff of which the music is made is well realised by the orchestra — it is recorded in a reverberant hall which, although it has given an attractive airiness to the sound, has remotely placed some sections which we would expect to hear close at hand and highlighted others for no special reason

A good example of this is the quiet section "The Hero's Helpmate" which according to Strauss was a picture of his wife.

This is very much concert hall, as are the trumpet calls which introduce the following section, the "Hero's Battlefield."

Here there is a definite sense of space which, if it wakes many echoes, is at least creative of the spirit of the programme.

It sounds more like a broadcast performance than a controlled recording.

You can easily count off the reverberation time constant of the hall in the short periods of silence after tumult.

Technically it has good hi-fi sound, marking it as belonging to the latest period of DGG in which both frequency and dynamic range have been much lifted from these of the older days.

Much of it is first rate. Incidentally, why did Strauss quote so freely from earlier works in the "Hero's Mission of Peace"? Maybe it is a nostalgic return to the past, but it always gives me an uncomfortable feeling, drowned as I am at this stage in the Strauss tone colour, that I have hold of the wrong disc.

A nice surface adds to the many good things about it.

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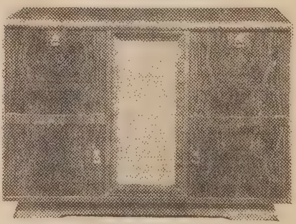

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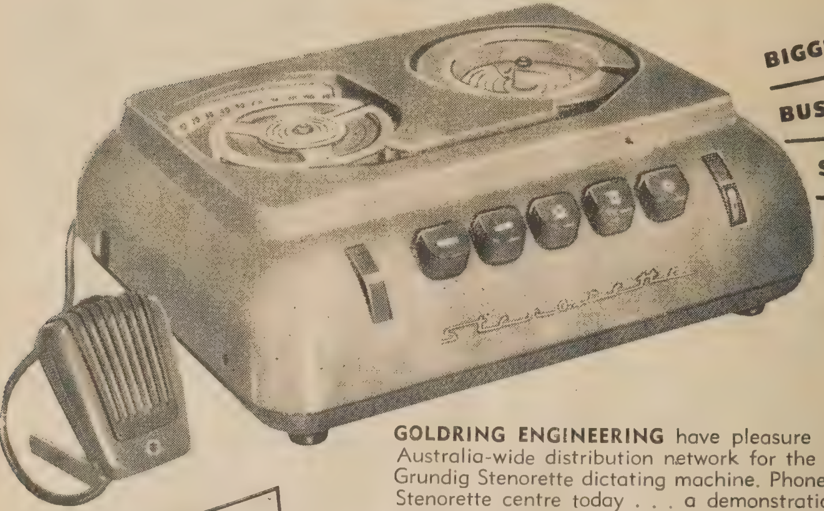

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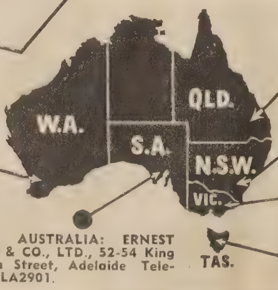

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A NEW "BARBER" IS WELL DONE

THIS new recording of Rossini's classic opera has a strong cast led by Callas and Gobbi. It features the Philharmonic Orchestra and is technically very good indeed

ROSSINI—The Barber of Seville, with Maria Meneghini Callas, Tito Gobbi, Luigi Alva, and the Philharmonia Orchestra conducted by Alceo Galliera. Columbia 33CX1507-9.

Since it must be assumed that anyone who buys a recording of the "Barber" does so because he likes the music, there isn't much point in discussing whether it is a good or bad thing to do. Enough people approve of it to have settled that question long ago. As with many operas I think it loses a great deal by being heard but not seen, but that, too, is not a very original remark

There is a particular application here, however, for the recording is obviously built around Callas and Gobbi as the stars, and neither has an ideal recording voice.

Callas on the stage is reputedly well worth seeing, but to the microphone she is only a voice. Or rather she is many voices, for her quality changes very greatly from one range to another. Occasionally, as when tossing off a light laugh as she does more than once in this opera, she makes what can only be classed as a strange and indeterminate noise.

Gobbi sings most attractively over his middle and lower range, but when the pitch rises and/or he puts on the pressure, he is betrayed into a lusty shout. It is particularly noticeable when contrasted with the clean-cut Callas, and the equally smooth tenor of the Count

It's true that Callas has taken great pains to avoid most of the tonal changes which were so obvious in some earlier operas. Her part here is mostly a light one, in which a flair for coloratura is much more important than the savage character we have heard in her singing.

And yet there are a few unhappy lapses from perfection. Some faulty pitch is heard in "Una Voce" of all places, and some full notes not distinguished by either grace or beauty.

But she has little trouble with the vocal flourishes which saturate the score—a contrast with Gobbi who is far less happy.

The smaller parts of Bartolo and Basilio are extremely well done, good voices and smooth performances.

The orchestra carries off the most consistent honors, although the overture is a much paler thing that it would have been had it been a concert performance. On the other hand it is supposed to be playing in a chamber which contains a singer and chorus as well, and a change in acoustics would have been bad.

And, incidentally, the chorus is always good.

Technically there is little with which to find fault. All the voices are clear, diction is good, and the balance between multiple voices carefully held. A few top notes from Callas showed a slight blast

Altogether the profit and loss sheet adds up favourably and there are no positively bad points It's a demanding thing vocally, and maybe that is why I would have liked a more relaxed atmosphere.

All three discs were well made, with surfaces clean and quiet.

ELSSOHN — Concerto and orchestra in E minus MAX BRUCH — Con- 1 in G minor for Violin estra Opus 26. Played by Ricci and the London Orchestra conducted by amba. Decca LXT 5334.

now too many issues of the to make comparisons worth is little to choose between hem, apart from the obvious both performances and re- h must occur between one and not necessarily im- ffecting the final score.

use it is one of the most certos I suppose we can ex- many more of them until of featured violinists.

nduly impressed with Ricci's but either they or he have oved in the meantime.

rformance is sure, brilliant ary and without affectation. way he handled the second t is quite free from heavy doesn't drag, but achieves of statement which I always key to this affectionate ex- composer's genius for sweet

o, the youthful flexibility of h which Ricci personalises

d over into the Max Bruch ys as though he thought it e does not talk it down any do the conductor and

ast between the passionate the first movement and the ity of the second I thought ely handled. Here again strates a straightforward h is much more convincing vily charged atmosphere it ives.

e said, there are several these two concertos, but on is one is in the upper class e is good and the recording modern Decca's clarity and h is first rate.

* * *

NSKY — Le Sacre du Firebird Suite. Played by ony Orchestra of South- an Radio. Conducted by onstein. Vox APL-10430.

hnical viewpoint I was in- of all by the playing time of Spring, given on the minutes 40 seconds, for a

y a huge slice of music to without a turnover, and a record of a record!

dd to it a complete record- rebird on the other side— d minutes—it is clear that, mercial angle, the value re- y high, and would offset mises.

ome of these, but they may ous to any but the really

cutting can scarcely avoid tween grooves, and we hear several places, notably at of the Infernal Dance, cedes the orchestral crash e music commences.

ive ear, too, will notice of heavy passages which, against the average level.

should have hit much higher spots. The end of the Firebird is an example of considerable compression at work, but it is fairly typical. Some muddiness at high volume may be due to both compression and groove intermodulation.

Neither performance is particularly penetrating or subtle, but they are by no means inadequate. The orchestra does not display the discipline of more famous combinations, but its inner instrumental work is often very good.

Surface noise is a little high, but I liked it on the E.M.I. setting anyhow, with which it is acceptable.

* * *

NIELSEN — Symphony No. 6 (Sinfonia Semplice) played by the Danish National Orchestra of the State Radio conducted by Thomas Jensen. World Record Club CS1.

This is claimed to be the only recording of the symphony in existence. I have no other version nor do I find it mentioned in any lists.

The jacket says it is a controversial symphony, and I'm sure this must be right, for its idiom is advanced, amusing, striking, often disturbing, and frequently capricious and baffling.

It shows a most remarkable pre-occupation with orchestral instruments as such. Nielsen is reported as having said "each instrument is like a person who sleeps whom I have to wake to life Finally I have come to think of the in-

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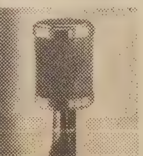

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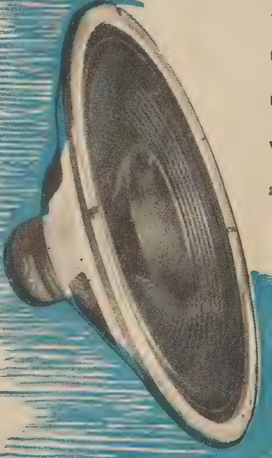

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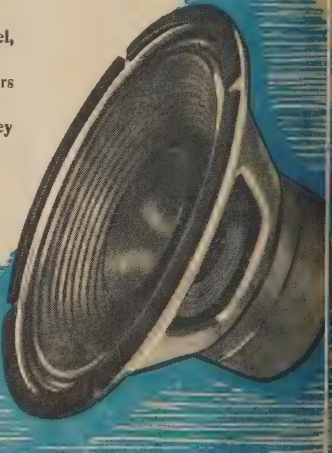


ROLA COMPANY (AUST.) PTY. LT

THE BOULEVARD, RICHMOND, E.1, VICTORIA. TELEPHONE JB 3

ıemselves as if I had crept
"

pertinent and illuminating
here are only brief episodes
onal or even recognisable
king to be heard—each time
oon dissolves into a session
us instrumental comment,
and dissonant sounds.

d movement, Humoreske, is
ıary interlude for small per-
hly reminiscent of a hi-fi
n disc supported by some
ises from trombones and

ly it is a riot of rebellion,
ageous air of a naughty boy
covered the potentialities of

essible quirk emerges from
e serious moments, and per-
wn to the raspberry flavour
and irretrievable comment
on as it makes an uncere-

nteresting, and exhilarating
not to say hilarious. In
dard it is worth half the
's entire output to date.
rding is extremely good,
nstration standard. It is best
miking of instruments, and
it needs to be strong. The
is good.

* * *

—Nocturnes Vol. 1;
Opus 15, Opus 27 and
Played by Alexander
. RCA L16137.

ormance, judged against
fine Chopin we have on
ns strangely tentative and
efined in many places,
ugh the pianist hadn't quite
mind what to do about it.

cupation with the right hand
appropriate, but it makes
ul as though it has been left
ind on occasions.

of this are heard in the
rne, perhaps as clearly as
well as in his sudden and
decisions to climax many
rs with variations in tempo

s, there is plenty to enjoy.
s no machine-made quality,
lack of sensitivity.

tone is good, not very for-
n the hard side But as
oes not hit powerfully, nor
ideas with a heavy hand,
to object to in this. It
le that the full set of noc-
e released eventually, and
bably be the most personal
nanding of any.
e is satisfactory.

* * *

DL — Royal Fireworks
er Music. Played by the
Philharmonic Orchestra
by Eduard van Beinum.
5379.

r taken aback by the high-
l as this record began to
nded as though someone
the R.I.A.A. curve from
although a quick check
it was still there.

iable boost restored the
obviously had no cut-off,
valent amount of top cut
alance I had initially look-

When so adjusted, the disc produced some most considerable music and certain aspects of the recording made me suspect it was intended to be that way, for great point is made of definition, particularly in the woodwind and the brass.

In the Fireworks music, particularly, where the music naturally divides, there was almost a stereo effect as one instrumental group answered another.

I have in fact suspected for some time that many recent discs are really monaural versions of what we shall eventually hear in stereo.

This one has a good deal of the quality we will expect from it.

The upper register accentuates very well the differences in harmonic timbre, and the impression of light bass isn't because it's not on the record.

The playing is clean-cut and athletic, but I thought the conductor could have aimed at a broader and grander effect at times. The end of the Water Music, for instance, is lively and brisk. But it does sound good with rather more flourish to it.

A good surface goes down on the credit side.

* * *

MOZART — Serenade No. 9 in D major K320; Serenade No. 6 in D major K239. Played by the Pro Musica Orchestra of Stuttgart conducted by Edouard van Remoortal. Vox APL 9890.

I can find little to quarrel with on this disc. Mozart's Serenades were in general devices to string together tuneful pieces of various moods. In them he included many of his most charming and rewarding compositions.

The Post-horn episode, which occurs in the penultimate movement, is of disarming simplicity, and I think it should be studied by every Boy Scout as an example of what can be done within the range of his traditional instrument.

The work of the Stuttgart players I thought was sheer joy. Without any great weight, but with exceptional sincerity and musicianship, they have not faltered in following through this lovely music.

Rarely have I heard such a beautiful interplay of instruments and so perfect an understanding between players. Particular praise is due to the wind and wood-wind, and special mention for the oboeist. Nowhere do the players earn it more than in the Concertante, rightly described on the jacket notes as one of Mozart's most delightful movements.

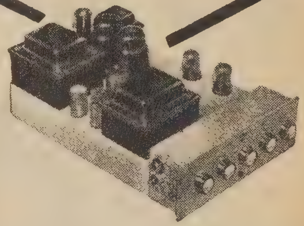
And yet they probably do no better than the strings in the following Andantino. I often wonder whether Beethoven was influenced by it when writing the slow movement of the Eroica. They have much in common, not only in what is said but in the mood of the saying.

The recording shows very clearly the orchestra's freshness and vitality. It has enough airiness to make delicate magic of so much musical texture, the strings are sharp without being shrill, and the balance is rarely at fault.

The Serenade Notturna is better known and less complex than the larger work, but the same fine standard of performance applies.

With a clean, quiet surface this disc could well become a favourite with me. I heartily endorse it.

25 WATTS
AM & FM
PYE
HI-FIDELITY
25 WATT ALL IMPORTED
AMPLIFIER & PREAMPLIFIER



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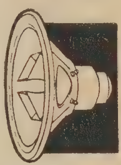

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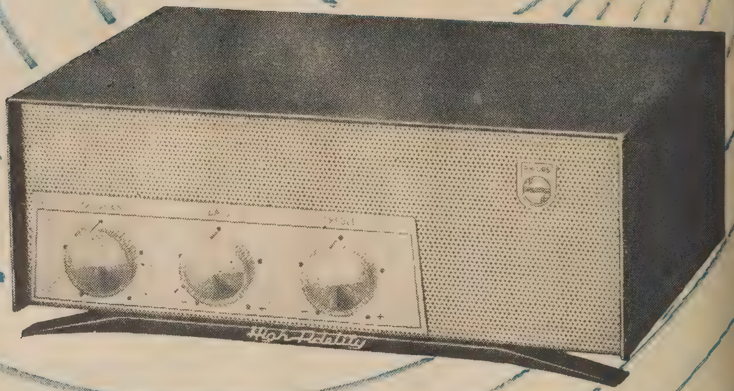

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The damping factor of the **EV4430** amplifier is more than sufficient to control overshoot and improve the transient response of speakers connected to it. The tonal balance can be adjusted to suit any listening conditions by means of the independent bass and treble controls. The variation in bass and treble response (by + 11 db to − 15 db in each case) is more than sufficient to suit individual tastes and listening room conditions. Hum and noise level is 67 db below full output.

Small and compact, the EV4430 measures only 10″ x 7½″ x 4½″. It has a durable cabinet finished in black baked enamel and matt chrome front with gold escutcheon and knobs.

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PHILIPS ELECTRICAL INDUSTRIES PTY. LTD.
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OVEN — Concerto No. jor; Sonata No. 27 in E us 90. Played by Solo- the Philharmonia Orches- ted by Herbert Menges. ALP 1583.

stra sounds more distant with the Philharmonia and very much to the fore. This me overmuch except for s of the slow movement chestra might just as well ome, although a few odd ed the fact that it had not.

ess that a move has been the often-used Kingsway gh it may have been ed miking to accommodate

whole it is a clear, taut mes from controlled acous-

endably free from coloura- rly the piano whose tone able.

ompetitor I have is Kempff tubby by comparison.

I thought it very good. es the first movement none of the vagaries of spoiled Kempff's otherwise

as such a fine sense of unswerving sincerity, that plays seems right and per-

is when you hear the final e first movement and the of the second.

not ask for better taste or

ovement, as might be ex- ry slow in the Solomon makes up for it by an al- handling of the last — id but his examination of of wit and life.

nate in receiving such co- m the conductor and ot once does their team their understanding flag. is one of my favourites tifully done. Solomon has etely its tuneful serenity, d its flow of imagination

ct surface, but above aver-

* * *

—Impromptu No. 1 in 29, Nocturne No. 8 in 27 No. 2, Etude No. 5 pus 10 No. 5, Mazurka minor Opus 67 No. 4, 3 in C sharp minor layed by Byron Janis. 132.

this young pianist impres- itality and wide range of hich he uses with an h, if not altogether care- ly prodigal.

I admire his ease of man- ltogether go for the man-

becomes conscious of a ound in whole sections of k it is an indication that quite right.

patti — he lacks nothing e vitality but he always the music was meant to

e reaches his top gear too ls he has nothing left — r levels off.

Not that he hasn't a fine ability to grade quieter moments in an exquisite fashion.

Rather it may be that he hasn't learned to temper his powers with the discretion that builds stature and commands acceptance.

I hope he will soon, because he is a very fine pianist.

The smaller pieces are admirably unsentimental, but are not completely convincing because, in extracting the sentiment, the pianist leaves the landscape bare of any substitute emotion.

What remains is extraordinary dexterity without enough warmth, great flexibility but not much lyricism.

I liked the Black Keys study and the Mazurka best of the five.

Now if you are an admirer of the dazzling standard of the modern pianist, particularly American, you will heartily disagree with much of what I have said. The safest way is to judge this lavish talent for yourself.

The recording is free from distress, most pianistic and nicely placed in the studio. The surface is quite good.

* * *

RACHMANINOFF — Symphony No. 2 in E minor Opus 27. Played by the London Philharmonic Orchestra conducted by Adrian Boult. R.C.A. Li6127.

Its competitor is the Leningrad's magnificent version under Sanderling. I say magnificent, because I have never heard a performance or recording which to my mind so completely captures the symphony as I imagine it was meant to be played.

Rachmaninoff was a man of strong and sensitive feeling, no stranger to mental strife and conflict. Moreover this symphony was composed at a time in his life when these characteristics had taken a bit of a beating.

The surge and movement of his music, its essential vitality and colour, must be preserved at all costs, no matter how strong the temptation to round corners and extend lines into sentimental and pallid shapes.

It would be an injustice to Boult to accuse him of doing either, but a comparison with Sanderling will show how much Boult has softened the tempest and checked the unrestraint which is never very far below the surface of this lovely work. In fact it is the emergence of this feeling through all its changing moods which largely gives it point.

I may be biased again, but there are things about the quality of the Leningrad orchestra which I think are superb in this field. Contrast the almost overwhelming intensity of feeling in the third movement, the climactic shape built up in the first few minutes, with the clear stillness that Boult achieves, and in it you have another example of what I mean.

There is even a touch of austerity in Boult's version which I believe has no real place. It is beautiful, but it should not be streamlined. Rachmaninoff certainly never was.

The recording is of high standard—it is sharper than the D.G.G. and rather less bodied, but excellently balanced and quite admirably articulated. Its surface is quieter, too. That's high praise but deserved, for my copy was virtually silent.

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MODEL 4/102
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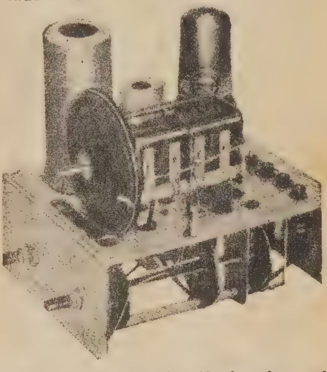

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SHORT-WAVE NOTES BY ART CUSH

FLASHES FROM EVERYWHERE

CAMBODIA signals from Radio Cambodia have been reported on the new 7190 Kc, when the transmission has been observed from 8 pm to midnight. The broadcasts include news in French at 11 pm, and reception of the station is now clear from interference since the recent move of Radio Biak in Dutch New Guinea to its former frequency of 5050 Kc.

Signals from the transmissions are received at good strength in California, from which a report comes that English news is scheduled to be broadcast at 10 pm.

BRAZZAVILLE, in French Equatorial Africa, has been using a new frequency, that of 11725 Kc, which replaces 11970 Kc. This new outlet is used in the 3.00 to 5.00 pm transmission which includes news in English at 3.15 pm.

The station also uses 15435 and 9730 Kc in parallel.

NORTH VIETNAM, with broadcasts from Hanoi, has been noted on a new frequency, that of 11745 Kc. And it has been heard on this frequency by Bill Hawthorne, of Warrnambool, Vic. The station has news in English at 7.30 pm, and at this time the station announces as in the 25, 31 and 63 metre bands, and these frequencies would be 11745, 9460 and 4770 Kc. The station was formerly on 15040 Kc, but does not now announce this frequency, though it has been heard with the broadcasts from 7 pm to after 10.30 pm. The station has an additional English news service at 2.00 am, when these frequencies are used with the addition of 1155 Kc on broadcast band.

WARSAW transmissions to North America have been noted by Kevin Dunham, of Narrandera, NSW, using the frequency of 11820 Kc with some interference when broadcasting at 1 pm. The station has also been noted on 17800, 15275 and 11705 Kc.

PRAGUE has a special programme of DX information as well as news for the radio amateur in the special broadcast on the first and third Friday of each month at 10.30 am and 3.00 pm. The special transmission for Australia carries the broadcast from 6.30 pm. Prague now broadcasts on 21470, 15180 and 11875 Kc, reports Ronald Pearson, of Parramatta, NSW. The address of Radio Prague is Prague 12, Czechoslovakia.

MOZAMBIQUE is the site of a new transmission noted by Cyril Anderson in Mt. Hawthorne, WA, which is presumed to be an outlet for the Portuguese programmes of the Radio Club of Mozambique. The broadcast was on 4750 Kc, but has now been observed on the outlet of 4700 Kc. The station closed at 5.30 am.

HONDURAS is a country seldom heard on shortwave, but the signal of RHN ("The Voice of Honduras") from Tegecagalpa, is at present giving good results at both 3 pm and 10 pm. The station is assigned 5960 Kc, but HRN now appears on 5850 Kc for both transmissions. The station is well known for its non-verification policy, but the recent trend of Latin American stations to come up with a confirmation of reception when least expected should not be overruled.

VANCOUVER is to be the site of a new 50,000 watt station for the Canadian Broadcasting Corporation. It is presumed this station will replace the present low powered station CBUX, which at present operates on 6160 Kc. This station relays the programmes of medium wave broadcaster CBU. The new station will relay the programmes for the listeners in the Yukon and MacKenzie areas of northern Canada. The station is expected to be completed in 1960, reports a listener to the ISWC London.

TEHERAN has made a slight frequency change, reports a listener in Austria. The broadcasts from Iran are now on 15135 Kc, with the programmes to Europe on the air from 4.30 to 6.30 am.

DAMASCUS, in its transmission to North America, uses 15165 Kc. Broadcasts in Arabic and Spanish, 10 am to 12.30 pm.

BOGOTA is the site of the transmitter of HJCF, which broadcasts on 5960 Kc. This Colombian station closes at 2.55 pm with the Colombian National Anthem. The station uses the slogan "La Voz de Bogota," and its signals are fairly strong though the close proximity of several other Latin American signals makes tuning more difficult.

ARGENTINA has provided good signals on the 49 metre band in the afternoons and the best signals are on 6120 and 6095 Kc. The broadcasts of LRY and LRX on these frequencies both provide good signals on Sunday afternoons, and the programmes are a mixture of both Latin and American dance numbers. Some interference from VL16 is noted on the 6095 Kc signal, but the other transmitter is more clearly received.

ANGOLA station CR6RM Radio Club de Mocamedes, is operating on 7230 Kc. The station is on the air with a power of 350 watts, 3.00 to 5.30 pm, 9.00 pm to 11.30 pm and 3.00 to 7.00 am. On Sundays, the transmission is 5.00 to 7.00 pm and 9.00 pm to midnight, with the Monday morning transmission from 2.00 to 6.00 am.

TOGOLAND has been observed in Europe on the frequency of 5036 Kc with 400 watts. The station is operating 4.00 to 6.00 pm, 10.00 pm to 11.30 pm, 4.00 to 8.00 am.

TAHITI has added a new frequency of 11825 Kc, which is used in the morning transmission. The station is on the air 8.00 to 9.00 am, while on Monday the service is 6.00 am to 9.00 am The evening transmission continues on 6135 Kc, to 5.45 pm daily.

PHILIPPINES station DZB6 is operating on 4945 Kc, with programmes of the Voice of Education. Reports from Japan state the station is operating 7.30 to 9.00 pm, but the sign on has been observed as late as 8 pm. The station relays DZTC, and is located in Manila.

BRAZILIAN station Radio Farroupilha, in Porta Alegre, is now using 9730 and 15335 Kc, with the callsigns ZYU59 and ZYU68. Sao Paulo station, Radio Julho, has been heard on 9620 Kc with Japanese from 7.30 to 8.30 pm, and the callsign on this frequency is ZYR96.

EQUATORIAL AFRICA station Radio Tchad, 9.00 to 10.45 pm, and 3.15 to 6.00 am on 6200 Kc, with 4Kw. From 10.45 pm the programme is released on 5905 Kc.

RADIO NEW ZEALAND'S 10th ANNIVE

Special awards for reports from listeners in Australia will be in the special broadcasts from Wellington this mon

THE activities of Radio New Zealand, which is so well received in Australia, were commenced on September 26, 1948, the country's Dominion Day. During the past ten years the service over the 7,500-watt transmitters has continued to cover the areas of Australia and the Pacific, and has met a response from listeners in all other areas of the world. The station operated by the New Zealand Broadcasting Service, has transmitters located outside Wellington, and the studios are located in the headquarters of the N.Z.B.S. in Wellington.

The special broadcast on Radio New Zealand during the week September 19 to 26 will include greetings from many overseas broadcasting organisations, as well as many special features.

A special verification card will be issued to all who report Radio New Zealand during the special anniversary broadcasts. This special QSL diploma will be issued in acknowledgment to the many listeners who have reported the signals of the station throughout the world.

In addition, a special souvenir award will be made to the listener in each country who supplies the station with the most informative technical report combined with the best identification of programme context during the period of the week's transmission within the hours of 4 p.m. to 5 p.m., and 7.30 to 8.30 p.m.

The award is for the technical report with particular emphasis on the programme identification covering the full period of the anniversary week within the hours we have mentioned.

Notes from listeners should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern.

Signals From Peru

INTERESTING signals from Peru have been noted in the past month, and these range from new stations in the 31 metre band to ones in the 85 metre band. A new signal has appeared on 9375 Kc and has been identified as OAX6L Radio Nacional at Tacna, Peru. This station has usual Radio Nacional programmes, though it does not carry the same broadcasts as Lima station on 9562 Kc. OAX6L leaves the air at 3.05 p.m. after the playing of the Peruvian Anthem.

Broadcasts from the Arequipa station, Radio Continental, have been noted on two frequencies, with the station closing at 4 p.m. OAX6E, which operates on 9355 Kc, at times suffers from interference from Madrid, but the OAX6X outlet on 3290 Kc, clearly received through this station, is becoming more difficult to hear.

Another low frequency signal is OAX1M Radio Progresso, with broadcasts from Peirua. This station used 3320 Kc, and the signal does suffer from severe interference from the
CHU.

This station of the Dominion
Ottawa Canada, has transmission
nouncements on 3330 Kc, and ca
ing to OAX1M to be unpleasan
Huanayco station on 5750 Kc,
with weak signals. The station
sign OAX4P has been observed in
the 49-metre band for several
present frequency is still one whi
interference from telegraphic stat
closes at 3 p.m. after the Per
Anthem.

Switching to Central America
broadcasts of the Mexican statio
again at good strength when the s
3.05 p.m. This station was men
but our listening finds the station
as XEMQ broadcasting band, a
shortwave. Formerly the callsign
both frequencies.

OAX7L on 589

THE reception of a new signal
not uncommon these days.
of OAX7L have been received
quency, which adds more to the
logging. The station is schedu
on 5960 Kc, but has been hear
with sign off at 3 p.m. The s
slogan, "La Vox de Altiplano."
broadcasts from Puno. The addres
is Calle Lima 700 in Puno. Re
fied by verification card, and the
Handbook lists a Foreign Broadcas
handles such requests for verificat

South African S

THE recent increase in power
African Broadcasting Corpora
transmitters at Paradyse to 20
notable for the better signals
Last month we featured the sch
mercial Service, Springbok Radio,
we release the transmission times
and Afrikaans broadcasts.

The English service is broadcast 2
and on Sundays from 3.30 to 5.0
Kc; 2.30 to 8.30 p.m. and Sunda
p.m. on 7229 Kc; 2.30 p.m. to 12
Kc; 4.59 to 10.45 p.m. on 11,900
to 3.18 a.m. on 7229 Kc; 12.49
4810 Kc; 3.22 to 7.45 a.m. on 33
missions on Monday are to 7.15
Sundays to 7.45 a.m.

The African service for listener
nent is on an experimental basis
from 9.00 p.m to 4.30 a.m. on 15
Kc. The broadcasts on Tuesday,
Saturday are in English and on
in Afrikaans.

The transmissions in Afrikaans
burg are as follow: 2.30 to 3.45
Kc, 7275, 9523 Kc; 3.49 p.m.
on 7275, 9523, 11,840 Kc; 6.04 p.
on 9523, 11,840 Kc; 1.04 to 2.30
9523 Kc; 4.34 to 5.15 a.m., on
5.19 to 7.15 a.m. on 3376, 489

United Nations C

THE Voice of the United Na
which has been in operation
conflict, has transmissions from
South Korea. A report from the
Wave Club that the reception
located in Japan is now to
given further interest in the broa

The VUNC transmissions and
in Japan use the Yamata 10kw tra
Kc, from 9 pm to 4 am, while
20 Kw of power when the trans
a.m. to 7.30 a.m. The broadcasts
quencies are in Korean, Mandarin
Additional coverage is given on
Osaka 100 Kw broadcast band
used to 2.05 am

In Korean two networks are
first is on the air 5.30 pm to noon
3765 Kc. The second network b
Korea is operating 10.30 pm to
7180 Kc.

Verifications from the station
issued by the Japan Overseas R
System, which is verifying the
and 6015 Kc. The transmitters
some 50 miles north of Tokyo,
the head office of the system in
acknowledged by a verification car

HAM BANDS WITH BILL MOORE

ls from the various nations covering the amateur bands to be presented at the ITU Conference are of general interest. In the U.S. where radio amateurs enjoy privileges in the way of spectrum space preliminary proposals provide for the continued use of all current allocations.

alterations to the requirements n on the UHF bands, American be reasonably pleased with the oposals. the first indication of eas that will be forwarded to

s cover amateur frequency allo- likely to form the basis of the quency requirements by the U.S.

or the continuance of all present y allocations.

oints out that the proposal is S. scheme, but as yet has to d approved by Government in-

ates that the recommendation eur privileges as at present (with difications) is a significant vic- ovement, and a testimonial to ateur radio in the past.

n operating conditions on the ove 220 Mc/s have already been e in view of the requirements nce for radio navigation and

f amateur bands changes, the orities felt that radio position- s can share these bands with al interference.

ever, one essential difference gulations.

se were exclusively amateur allo- amateur had the right to inter- d positioning. Now the latter must suffer no interference from ce.

cording to statements, the new have little effect on normal amateur working on the UHF bands. In isolated cases the amateur may have to change frequency within the band. In some areas close to missile launching stations, amateurs may not be permitted to use certain UHF bands; this condition has applied for a number of years.

The recommendation leaves the 50 and 144 Mc bands intact with no restrictions. The UHFs from 220 to 21,000 Mc/s all carry the restriction that no harmful interference be caused to radio positioning.

In the reallocation the Government took frequency space from fixed and land mobile services for extension of radio positioning allocations.

Generally, the proposals publicised to date have been received with satisfaction, and it is anticipated that the final proposition to be submitted at Geneva will vary little from those listed above.

Another interesting feature from the U.S. is the decisions reached at the 1958 meeting of the ARRL Board of Directors.

Those concerning regulatory changes will be submitted to the FCC for consideration and some of these are as follows: To further amateur contribution to the knowledge of long distance propagation on the VHF bands, the board will suggest the use of an exclusive CW allocation of 100 Kc/s on the low edge of both 50 and 144 Mc bands.

They will also request a 50 Kc extension of the 14 Mc band telephony allocation. The majority of the board members voted against proposals to increase the telephony allocations on the 3.5, 7 and 21 Mc/s bands. The majority of the decisions reached concerned domestic matters, but any determination on frequency allocations can have a marked effect on overseas stations due to greater number of W stations operating.

OMING EVENTS AND AMATEUR CONTESTS

S.W. amateur events take place r the Six-Hour Day weekend in Hunter branch will hold their Field Day at Blackalls Park ir annual dinner. The South ill conduct their sixth annual

anch commence their weekend inner at the University of Tech- ill at 7.30 p.m., Saturday, Oc-

hall, Minister for the Interior B, will propose the toast, "Ama- the Wireless Institute of Austra- le. VK2JU, will be the guest

will be conducted between 9.30 n. on the Sundays, commencing sale. A 7 Mc/s Scramble, 144 unt and All-band Scramble fol- s and races will also be con- L's and juniors.

e field day, dinner, and hotel required should be directed be- 7, to G. Sutherland, 15 Marine

ern Zone's convention will this Canberra; this follows the nor- anging the venue annually. with the Canberra Radio So- on will run over two days, and be the society's rooms at River-

fternoon will be taken up on a and its surrounds. evening a dinner, film show. be conducted. l be taken up with field events, d scramble. 144 Mc transmitter blindfold—will be run. A dis- e held. Good prizes for all available and the society offers the best piece of home built

requests for accommodation to Ken Finney, VK2AIL, Box T., deposit £1.

ontest

inly a busy month for amateurs. be geared up for operation in DX contest. At the time of ugust, the 21MC band has just a midwinter hibernation. By ls 28 Mc/s to 7 Mc/s should

section will be held over the 4 and 5, and the CW section on October 11 and 12. This year's contest will be conducted by the NZART.

The CQ world-wide contest also commences in October. The telephony section to be run on the last weekend in that month and the CW section on the last weekend in November.

BERU won by VK2GW

THE 1958, the twenty-first B.E.R.U. contest, was the best supported for many years with an increase of over 25 per cent in the logs received from overseas. Propagation conditions were good during the test and support for DX contests generally is on the improve.

Lyell Woolnough, VK2GW, leading VK CW contest stalwart these days, was the winner in our area for the senior section. Jim Tutton, VK3ZC, was the winner in the junior contest

The ITU Fund

THE collection sponsored by the Wireless Institute of Australia to finance the sending of an accredited amateur delegate representing Region 3 at the I.T.U. conference, Geneva, is receiving excellent support. The unofficial total received to the end of July was quoted at £1,500. Most amateurs consider the sending of a delegate is a necessity to ensure the movement's viewpoint is effectively presented.

Donations are solicited from all amateurs and interested persons.

Covering letters of explanation were forwarded to all amateurs. If you have not as yet made the effort, the donation should be forwarded to the W.I.A. Federal Executive, Box 2611W, G.P.O., Melbourne, or via your local State Division.

All donations will be acknowledged in "Amateur Radio."

N.S.W. Division Progress

FROM time to time individual officials come to the fore in the Wireless Institute of Australia and maek an unforgettable impact on the movement with their devoted attention to the position they hold. In most cases these amateurs make tremendous personal sacrifices to ensure all phases of their work are fully covered.

All N.S.W. amateurs will pay full credit to Norm Beard, VK2ALJ, divisional secretary, for the way he is carrying out his duties.

The growth of the N.S.W. Division in the last 12 months has been remarkable, due to work of an active council and other individual office-bearers. The election of an average of over 30 new members each general meeting is some indication of the support afforded the division.

Amateurs and Satellites

AMATEURS in Australia were complimented on their work performed during obversations on the transmissions from the American and Russian satellites. They are still active with renewed interest on the launching of the fourth American satellite.

The R.S.G.B. programme for covering Sputnik III was arranged with the Royal Society IGY Artificial Satellite Sub-Committee. The members making observations were requested to concentrate on two features:-

Firstly on recording telemetry signals and secondly on the reception of beyond the horizon signals. Two tape recording groups were set up for the purpose. These recordings were transcribed to paper tapes to enable initial measurements to be made and a full analysis will be carried out when further information is made available.

In South Africa amateurs concentrated on recording signals from the American satellites. A large amount of data was collected and Doppler measurements taken.

Signals on 108 megacycles were received up to a distance of 4,000 miles.

The Dutch amateurs, too, observed American satellite transmissions and recorded anomalous propagation effects when these satellites were beyond line of sight.

DX Operation

SUGGESTIONS have been made from time to time on how to eliminate the stacked stations that appear on the DX bands whenever any of the rarer prefixes show up.

These chaps really take a beating. It is not so objectionable if they are on DX-pedition but otherwise their operating life is a misery from the crowd of stations calling them.

You can notice them disappear into hiding when the hordes appear.

Surely they should be permitted to enjoy a quiet contact if they so desire.

It has been suggested that if DX operating awards were limited, the pressure might be eased. For instance no credit above 100 countries should be granted for DX CC and that tallies of countries or prefixes worked should be eliminated. Similar restrictions could be applied to other awards and so relieve the tension on the DX-ers of today.

It might allow some of these rare stations to come out of their seclusion and contact whom they like when they like.

The Atlantic on 144Mc

PUBLICITY is being given to the possibilities of bridging the Atlantic on 144 mc/s and Ed Tilton WLHDQ QST VHF scribe has been offering comment on the possibility of such work. It was tried some years ago by the International VHF Society and it is hoped some similar scheme will be instituted. One disadvantage is the limited power permitted to most European stations.

If the record 2540 mile 144 Mc contact between KH6UK and W6NLZ is any indication of the preliminary organisation required, there is a deal of work ahead of any contenders for the honours.

The tropospheric KH-W6 contact was no fluke. It was repeated, but the original QSO took nine months of schedules, kept regularly at all hours, before the record was established.

To perform the feat the amateurs will have to equip their stations with the ultimate in apparatus, spend plenty of time, and perhaps enjoy a little luck.

The 50Mc Band

SOME indication of the 50 Mc DX working during the past season can be obtained from the 50 Mc W.A.S. rating. E12W has now worked 35 of the 48 States, SM7ZN-29, PZ1AE-26, SM6ANR-24, SM6BTT-23, LA9T-20.

The 12,000-mile 50 Mc DX record of LU3EX and JA6FR is being challenged. Currently the Brazilian National Society claims a PY2AXX-JA6FR contact as a record, while the Japanese National Society supports a JA3EK-PY3BW QSO.

It appears that the Japanese and South Americans have these records in their keeping for al time. They are not only half a world apart but both enjoy high F2 MUF's and effective tran-equatorial scatter.

E12W, the first amateur to work from Europe to the west cast of America on the 50 Mc band using F2 layer propagation, obtained his best results with a tilted array. Tilted at 50 degrees he wondered whether a division of the F2 layer is taking place and a new layer above F2 is becoming increasingly ionized.

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ests

W. WICEN official run provided
erience for members. Officially
ges to and from country net
ndled. An interesting feature of
as the carrier control of the
er at Dural by the means of a
The station was operated from
State Emergency Co-Ordinator,
K2ARG. Dave Duff, VK2EO
VK2WI, with Mr Allan Grant
fficer from the C.D.O. The lat-
nent on the message handling.
conducted most Tuesday nights

asts from Dural are now trans-
usly on the 3.5, 7 and 144Mc
ng extremely effective coverage
ntennas the signals are well re-
ts of the State.
anned for the full 24 hours of the
it is hoped the score will help
otal. The larger Divisions have
winning under the amended scor

Mast Erection

in the June issue was the problem
K. amateur G8RY, who was re-
by the local municipal authorities
ple 40-foot poles to support his
.G.B. officially endorsed his ap-
nted out the work of amateurs in
939-1945 war and other activity
field, etc.
f Housing and Local Government
n for the erection of the masts.
is appeal can have an important
applications.
pressed the opinion that the masts
or engineering operation within
the section of the Act. and
vould be required to erect them
not satisfied, however, that the
oment would cause such harm
justify refusal of planning per

ot poles were erected in accord-
plans originally submitted.
eviation that dates back a long
used by telegraphists as a signal

n the U.S. in the days of the
Andrew Carnegie administered
nd Railways.
he war the Order of Military
formed. Upon Andrew Car-
he age of 73 the Order gave
ner. From this the term 73
as a symbol of good wishes.
r, VR2DA (ex VK2PA, Port
his best wishes to all his
nly operates 14 Mc/s these days
18 months he should be back
and hopes to meet them person-
particularly like to hear from
AVG, last heard of in Brisbane.
Ted.
K2AIR, and VK2AYY/LH, from
d, battled hard to get amongst
ow frequency bands. Apparent-
not a very suitable location for
an's review of his DX-pedition
contacts, will make interesting

July nocturnal 144 Mc Fox Hunt
N.S.W. VHF and TV section.
n, VK2ZCF, in first place. Jim
M second and third Dave An-

VK2ARZ, lectured at the July
he N.S.W Division of the WIA
on of amateur equipment He
items including an R/C Bridge
itor. The latter item was con-
for use at VK2WI to assist in
ks.
the September meeting will be
VK2PW, and his subject 7mc
t, what to build and how to
operation is becoming increas-
ongst amateurs and the lecture
n interesting insight into this
n.

.C.P. CLASS

.I. Victorian Division.
lass will commence on
rd November, 1958.
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nd Theory on Monday
om 8 to 10. Persons
being enrolled should
e with the Secretary
ctorian Division, 191
et, Melbourne. (Phone
m 9 a.m. to 4.30 p.m.)
Manager, on either of
above evenings.

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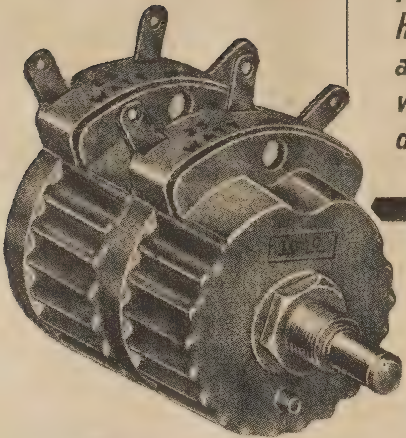
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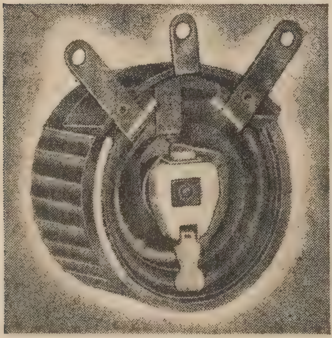
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ANCE — CAPACITANCE BRIDGE

(Continued from Page 37)

lug and their respective

ıg supports one end of the oad of the indicator valve. ports one end of the coupand the shielded lead gon control.

wiring is grouped between or control and the selector mmon ends of the standorted by a two lug strip by the 6U8 socket retaine piece of spaghetti sleevrectly above the 100 pf itor, covers the correction h is made up of two pieces C hookup wire held firmly distance of about 1¾in.

warning here may not be When wiring the standards ke extreme care. Excessive application of stress to ay result in a permanent ıe.

HE STANDARDS

course to adopt in wiring ip the component by the pair of long nosed pliers, ody. Any bending of the w be done with the fingers d of the pigtail. The same lies to soldering, the pigped with the pliers in order heat away from it.

nponent requiring special germanium diode. This is thode or positive end to a negative-going signal is grid of the indicator valve. ode is easily distinguished arked end.

on so'dering procedure, eceding paragraph for the equally applicable to the essive heating may easily

indicator circuit consists neon of the 70-volt type. a .47 meg. limiting resistis anchored between the a three-lug strip which is d on the front panel close dator cutout. The neon eld in place by friction hrough a grommet, which le provided for it. Conhe neon is made directly the terminal above it and ng. resistor.

constructional item is to al pointer by attaching a x to the rear of a suitable ountersunk screws. This o be secured to the shaft d accurately.

ut the dial scale graduae tried to spread errors have been due to an indimeter, so that the general d be quite good.

f you have your own facirating and marking scales, son why a new one should d over the original, makremaining panel markings. ou will be no worse off eft the space blank.

spread of the scale should be about right for a standard IRC wirewound potentiometer, as used in the earlier circuit. In this case, the 75-ohm resistor shown in series with one lead should be omitted.

On the other hand you may care to use a more expensive potentiometer, in which case a Naunton type, having a diameter of just under 2 inches, would be a good choice. One of these is shown in the finished instrument.

The angle of rotation of the Naunton potentiometer is slightly different from the IRC and it was necessary to wire a 75 ohm resistor in series with one end of the potentiometer to spread its travel.

ATTACHING THE POINTER

The resistor can be connected at either end of the element or it could be made up from two resistors, each about half the value, one at each end. The resistance should be an accurate 75 ohms to begin with, but if you have standards to work against, it can be varied either way and treated as a means of calibrating the potentiometer exactly against the printed scale.

However, whether you use an IRC potentiometer without a resistor or a Naunton with it, the first step is to set the pointer so that it reads centre scale with the switch set to read "Value" and a component across the "unknown" terminals exactly equal to one or other of the internal standards.

An obvious course is to buy, say, two accurate 100-ohm resistors, one to serve as an internal standard and the other to allow the pointer to be set to centre scale. If the remaining standards are correct, setting the pointer to centre on one scale should automatically make it right for the other scales.

If you wish to check the accuracy of the instrument on the limits of travel, 10 times up and 10 times down, you will need access to suitable resistors. As already mentioned, a degree of adjustment can be obtained by varying the value of the 75-ohm resistor.

CHECKING THE TOLERANCE SCALE

Note that any variation in this resistor will shift the whole scale distribution, requiring the balance position to be reset before the effect of the judgment can be judged accurately.

To check the tolerance scale, set the bridge at balance with, say, a 100-ohm resistor in the "unknown" terminals. Then switch to "Tolerance." The balance should ideally remain perfect. If it does not, there is some discrepancy between the two 5600-ohm resistors which are now introduced into circuit. One or other should be shunted down or else have a small series resistor added, till balance is maintained with the switch in either position.

Once again, anyone with standards available can modify these two resistors to calibrate exactly against the tolerance scale.

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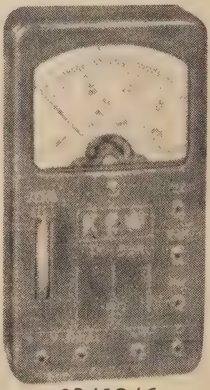

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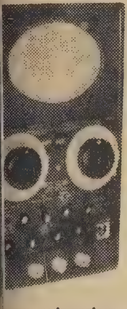

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EV 3BZ MITTERS

ion 2 to 10 Megs.
ste Perfect order.
ith P.M.G. requirements.
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ITH 1 CRYSTAL.
/10/-

NCEIVERS

ves and meter, £3.
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ves and meter, £3.
udi 15 octal valves and
p. meter, £5/15/-.
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ion For original use
s conversion.

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American No. 536 Transceivers.
Complete with Valves.
£4/17/6

NEW HIGH IMPEDANCE HEADPHONES

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Postage 2/6.

AR8-AT5—COMPLETE STATION

AIR TESTED

Transmitter-Receiver. Aerial Couple Cables, Plugs, Phones, Mike. 1 Crystal to desired Frequency. 24v. Power Supply and Circuits of 2 units.
GUARANTEED IN PERFECT ORDER.
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Other voltages available.

12V Lighting Plants

Johnston 300 watt direct coupled in 1 H.P. petrol engine. Tested. Perfect order.
£36

NEW VALVES

217C	10/	VT502 ..	12/6
12C8	12/6	AV11	3/9
6J8	17/6	6K7	5/
VT501 ..	12/6	12SJ7	12/6
2D21	15/	12SK7 ..	5/
6L6	20/	12SL7 ..	12/6
1C6	12/6	39/44	10/
1J6	12/6	46	12/6
1P5	2/6	47	12/6
6A6	12/6	78	12/6
3A4	15/	828 ..	£2/10/
3B7	10/	843 ..	£1/10/
3D6	10/	957	10/6
6AG5	7/6	1625	£1
6AM5 ..	15/6	1629	10/
6AM6	17/6	4307A	10/
6H6	2/6	1619	£1
6J6	15/	2050	£1
6J7G	7/6	9001	8/6
6N7	10/	RK75	10/
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12A6	2/6	RK48A	£3
2A3	£1	954	7/6
KTW62/6U7	7/6	VR105/30	15/
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6X5	10/	83	10/
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1Q5	2/6	866A	15/
811	10/	6AC7	2/6
6E5	12/6	EF50	2/
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12K8	12/6	5R4GY	£1
1T4	10/	6AJ5	9/6
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Complete with Filter.
Hi-speed. Ball-bearing.
2 cu. ft. per minute.
Ideal for small spray gun, etc.
£3/17/6

New Microswitches 6/6 each

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240V AC, 1/20 h.p. Motors

Series wound, 7,000 r.p.m.
£2/17/6

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300 x 300 100 6v. £1 17 6
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6v., 240v. 40 watt £3 7 6
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350 x 350 extended to 1000v.
6.3v., 6.3v. 215v., 4v. .. £4/5/-.
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285 x 285 60mA £1 17 6
285 x 285 80mA £2 7 6
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240v. A.C.
295 x 295 300mA . £6 15 0
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12 amp. Fils £8 5 0

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6v. 3-Pole Miniature 15/-
1700 SPDT 7/6
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½in Square Section DURAL TUBING UP 24 12ft lengths, 1/- per ft.
Hi-lo Phono Transformers .. 4/6
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100 yards £2/17/6
Tx Var. Condensers, 300 pf. £1/5/-
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60 pf with Vernier £1 1/-
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INDICATOR UNITS for that C.R.O. project

Cabinet, CRO tube, 2¾in ACR10 Socket, Mount, Shield and Graticule.
£1/7/6

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Type R.F. 27 Tuning Units

Ideal for TV or F.M. front ends.
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NEW Indicator Unit

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3 valves, VCR139A CR Tube.
Cabinet Socket Mount for Tube Pots, etc.
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F.M. Transceivers. Bat. and power. 18 valves. 25 to 38 Megs.
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New Smith Aircraft CLOCKS

8-day movement. Cost Govt. £28
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2¾in with sweep hand .. £5/15/-

New Coils and Intermediates Standard or miniature to suit all valves

Coils B/C 455 KC 9/6
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GENEMOTORS

Input.	Output.		
24v.	250v. 100mA	£1 0 0
24v.	550v. 375mA	£2 0 0
24v.	250v. 60mA	£1 5 0
12v.	500v. 350mA	£8 10 0
12v.	1200v. 200mA	£6 10 0
24v.	250v. 100mA. New	£2 0 0
12v.	235v. 50mA	£2 15 0
12v.	350v. 50mA	£2 15 0

I.F.F. UNITS

11 Valve Genemotor Powered.
Excellent for Parts.
£2/15/

TELEPHONES

Standard P.M.G. Type.
Pedestal Magneto Phones, tested, in perfect order.
£6/10/-

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E.M.I. Hi Coercivity Tape.
Ex-A.B.C.
3250ft Platters £2 10 0
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No. 22. Complete with Valves, Power Supply, Mike, Phones, Plugs and Cables.
The addition of Crystals to this set conforms with P.M.G. requirements for small ships, bushfire brigades.
£12/17/6

WANTED

Communications Receivers. Test Equipment, P.A. Gear, Large or small surplus stock. Best prices. Call, write or phone any time

Oil-filled Condensers

1UF 600V, 6/6 5UF 2.5V 6/6
4UF 750V, 12/6 5UF 400V 6/6
10MFS 500 7.5UF 330V AC 10/-

COMMAND RECEIVERS

and Transmitters
Complete with Valves.
£3/17/6 each
453 Q5ER Receiver, £6/17/6.

No. 128 Transceivers

New Condition. Complete with Valves.
£7/17/6

NEW 12V Generators

550v. 350mA £8 10 0
250v. 100mA £2 15 0

M.B.H. Pre-amplifie

LABORATORY TESTED

M.B.H. PRE-AMPLIFIER
SELECTOR
BASS
TREBLE
VOLUME
HIGH FIDELITY PRODUCTS HOMEBUSH N.S.W.

It is very important that the units of a high fidelity music system should be matc
ed. There are compromises in those pre-amplifiers designed to suit all types
pick-ups which preclude optimum results.

The M.B.H. PRE-AMPLIFIER TYPE 4 is designed to suit M.B.H. pick-ups. It has a se
ector switch, volume control and an auxiliary input. The extra wide range bass a
treble controls are graduated in decibels from +16 to −16.

The use of 3 EF86 valves with heavy feedback gives the lowest distortion of a
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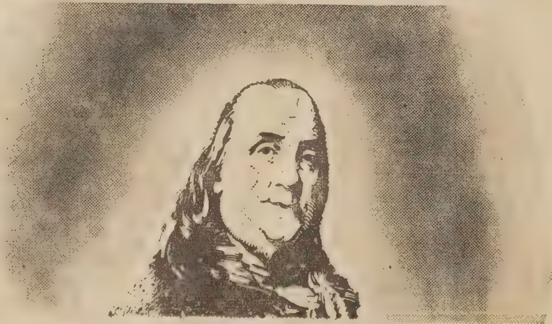
FOR FINEST SOUND—USE AN M.B.H. PICK-UP WITH AN M.B.H. PRE-AMPL

ENQUIRE AT LEADING WHOLESALERS OR WRITE TO ADDRESS BELOW
HIGH FIDELITY PRODUCTS, 19 MARLBOROUGH ROAD, HOMEBUSH WEST, N.S.W

WHAT SECRET POWER DID THIS MAN POSSESS?



Benjamin Franklin (a Rosicrucian)

Why was this man great? How
one—man or woman—achieve
Is it not by mastery of the powe
ourselves?
Know the mysterious world wi
Attune yourself to the wisdom of
Grasp the inner power of yo
Learn the secrets of a full and
life! Benjamin Franklin—like m
learned and great men and wome
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Please send me the *free* book, "*The Mastery of Life,*" which explains how I may learn to use my faculties and powers of mi

Name
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City State

IPLE SPEAKER BAFFLE

ued from page 49)

this board by means of olts or wood screws.

serting the baffle into the a piece of expanded aluther suitable speaker grille attach this either to the r the baffle board. The w be secured to the front ood screws.

even filter panels of caneite sound-absorbing material. are cut to fit neatly into and spaced one from the den frames. The frames e from either rough or finishing 1¾in x ¾in.

panels have circular cutrically placed and graded, tout being closest to the diameters of the circles eaker are as follows: The just clear the speaker cond to have a diameter hird and fifth a diameter urth and the sixth a diawhile the seventh has a in.

SINGLE SHEET

holes reducing the largest st in regular steps that most flexible arrangement t. They are cut from

with their wooden spacers sembled into a pack, held ur brass rods threaded on the whole assembly tights and suitable sheet-metal

o ensure that the holes ur corners of the caneite rm the following method pful: Insert the partitions sure, then place a length suitably ground tip in the ll, and pierce the assembly corner.

s are then withdrawn, and bled as a pack or inserted n to the rods in the enassembly is made rattle ing the nuts.

speaker is used the diaholes may have to be deough we cannot give exact e hole diameters would ase roughly in the same those for the 12in speaker.

TONIC PUZZLES
D GAMES

IC PUZZLES AND Mathew Mandl, published Library. Soft cover, 128 illustrated.

book for those interested approach to electronics, eacher, student, or hobbyesigns use simple equipg mainly of switches, dry s and relays. It is thus o the young hobbyist, and are perfectly safe.

irect from the publishers, brary Inc., 154 West 14th k 11, N.Y. (P G.W.)

HERE'S YOUR ANSWER, TOM!

(Continued from Page 47)

sistor and is made up of the valve output capacitance, the input capacitance of the following valve and the stray capacitance of the coupling capacitor to ground

At the high frequencies the reactance of the capacitor becomes lower until it approaches in value the resistance, so that portion of the signal is bypassed to earth.

The coupling capacitor also has an important bearing on the functioning of an amplifying stage. Its size may have some effect on the high frequency response by virtue of its capacitance to ground but it mainly affects the low frequency response.

With the grid leak resistor, this capacitor forms a divider network. The voltage developed across the resistor only is applied to the grid of the valve. Consequently if the reactance of the capacitor is high compared to the value of the grid leak, the voltage at the grid will be reduced. This condition is most likely to occur at low audio frequencies.

It is not practical to use too large a value of coupling capacitors, so the designer always aims to make the grid resistor as large as possible, consistent with the operating conditions of the valve.

VACUUM MOUNTED CRYSTALS

for general communication frequencies in the range 3-14MC. Higher frequencies can be supplied.

THE FOLLOWING FISHING CRAFT FREQUENCIES ARE AVAILABLE IN F.T. 243 HOLDERS
6280, 4095, 4535, 2760, 2524

AMATEUR TYPE CRYSTALS 3.5 AND 7 MC BAND

Commercials — from £3/12/6 each, plus 12½% Sales Tax.
Amateur — from £3/-/- each, plus 12½% Sales Tax.
Regrinds £1/10/-.

Crystals for Taxi and Bush Fire Sets also Available

We would be happy to advise and quote you as to the most suitable crystal for your particular application either in the pressure or vacuum type holder

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BRIGHT STAR RADIO
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AVAILABLE FOR IMMEDIATE DELIVERY

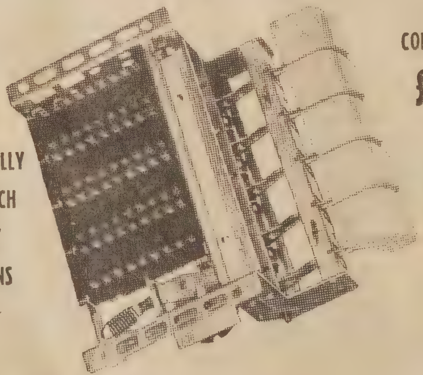
6 BANK PIANO TYPE PUSH BUTTON SWITCHES
(including off switch)

IMPORTED CONTINENTAL TYPE

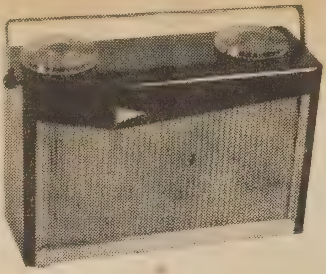
£2 each
INCL. FREIGHT

Special price to manufacturers and trade on application

A BEAUTIFULLY MADE SWITCH WITH MANY APPLICATIONS



L. G. WALKER 243 ELIZABETH STREET, SYDNEY OR
ELECTRONICS (AUST.) PTY. LTD. Factory area Welshpool, W. A.



MAKING R. & H. TRANSISTOR PORTAB

COMPLETE KIT OF PARTS

£26/10/-
POST EXTRA

SET WIRED AN
TESTED £2 EXT

INCLUDING 6 S.T.C.TRANSISTORS, R.C.S. COILKIT
PRINTED CIRCUITS, ROLA TRANSFORMERS AN
SPEAKER & ALL PARTS NECESSARY TO COMPLETE
SET INCLUDING ATTRACTIVE & DURABLE TWO
PLASTIC COVERED CABINET.

New Power Transformers

60mA prim.: 240v with 230v tapping, Sec. 285 x 285 with 6.3v filament winding, 60mA.

27/6

Plus Postage: N.S.W., 3/6; INT., 5/3.

NEW 4in Per-Mag. Speakers

5T. or 7T. Trans.

30/-

Post. and Packing, 3/6.

New Midget Power Trans.

40mA Prim. 250v Sec. 225 x 225 with 6.3v. Fil. Winding. Upright or Flat Mounting. Size 2in x 2½in.

25/-

2/6 Postage, N.S.W.; Interstate, 4/6.

30mA. 240v. Prim. 150 x 150v Sec. with 6.3v. Fil. Winding.

22/6 **Postage, N.S.W., 2/6; Interstate, 3/6.**

BUILDING R. TV & H. TV SET?

All Major Parts in stock, including R.C.S. IF Strips and Tuners, Valves, Power Transformers, Chassis, etc.

NEW DYNAMIC HEADPHONES

These headphones made by Rola are a high-quality unit giving excellent tone. Fitted with comfortable ear pads.

25/- **Post 4/6.**

New No. 7 HAND MICROPHONE

with Switch Dynamic Unit.

20/-, plus Post.

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20/- will purchase any one of the following Valve Specials.

10	1P5	3	1S5
6	1C7	3	6K8G
10	1Q5	8	6SH7
12	1K5	8	6AC7
10	954	6	6J7G
6	6C8G	4	6U7G
10	EF50	5	12A6
12	VR65A	2	6X5GT
3	1T4	7	6K7G

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ALL VALVES ARE NEW.

NEW 6H6 OR 6H6GT VALVES

Individually Cartoned.

12 for 20/-

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New Transmitting Valves

803	30/
100TH	15/
866	12/
811	15/
830B	12/6
809	10/

Special price for quantities.

New Micro-Ammeters

New Paton Micro-Ammeters

0-500 mA, 1¾in diameter. Flush mounting.

25/-

Post and Packing, 2/6.

CONDENSER SPECIAL

Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper Values include .0001, .00025, .00075 .01, .02, .05, .1. Also 500 mfd/12v., 10 mfd/40v., 16 mfd/350v., electrolytics.

25/- per 100.

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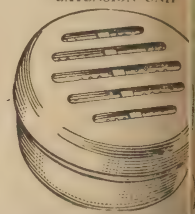
PILLO FONE

EXTENSION UNIT



IT'S A REAL MINIATURE W UNIT. Install it anywhere, in th workshop, garage or any room in Just connect across voice coil of speaker. The "PILLO-FONE" IS CONVENIENT LITTLE UNIT YET 3½in Diameter by 1¾in deep.

POST FREE .. ..

NEW I.R.C. RESIS

I.R.C. carbon resistors, ½, 1 and values 50 ohms. to 5 meg., incl popular sizes, 3T, 15T, 20T, 25T, 250T, 500T, etc.

(Standard resistor colour code s

100 for 25/-

(Plus 1/6 postage.)

NEW HIGH IMPED. HEADPHONES

30/-

Telephone Genera

New small telephone generat for bell ringing, etc.

7/6 **Postage**

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for that Crystal Set, 6/-, PO

NEW VIBRATOS

A.W.A. Oak 6-volt Synchronous 7-p
A.W.A. 12 V Synchronous octal ba

Post 1/6.

VALVE SOCKE

9-pin Ceramic Loctal .. ..
5-pin Amphanol Ceramic.. .. .. ..
8-pin Loctal .. ..
Acorn Ceramic .. ..
7-pin Miniature .. ..
9-pin Miniature .. ..
8-pin Octal .. ..
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Post Extra.

Please address all correspondence to 332 Parramatta Road, Stanmore, N.S.W.

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PHONE LM
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CIAL PURCHASE—HI-FI AT LOW COST

VE DUAL WAVE HI-FI CHASSIS WITH DUAL SPEAKERS AND LATEST COL-
4-SPEED RECORD CHANGER WITH CRYSTAL PICK-UP. THE TWO UNITS

EW 7-VALVE HI-FI CHASSIS USE THE LATEST PHILIPS 9 PIN VALVES IN-
THE DUAL-PURPOSE 6BM8 VALVES IN PUSH-PULL OUTPUT.
180 "MAGIC EYE" TUNING INDICATOR, SEPARATE BASS AND TREBLE CON-
TTRACTIVE PLATEGLASS DIAL AND SUPPLIED WITH JENSEN M.S.P. DUAL
S, 12in WOOFER AND 6in TWEETER. F.O.R. Packing 10/- extra.

£39/17/6

NEW VALVES AT BARGAIN PRICES

	4/6
	10/
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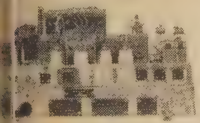
	12/6
	12/6
	9/6
	9/6
	10/6
	9/6
	9/6
	10/
	10/
	7/6
	10/6
	9/6
	12/6

6SH7	3/6
1Q5G	5/
1P5G	5/
1C7G	5/
1K5G	2/6
6AC7	2/6
6C8G	7/6
6SS7	8/6
6F6G	9/6
6H6	2/6
6H6GT	1/6
6J7G	7/6
6K7G	3/6

6K7GT	7/9
6U7G	6/6
6Y6GT	12/6
6J7G	5/
6U7G	5/
6J6	15/
6F8G	10/6
6A3	15/
7C7	3/6
7A6	3/6
78	7/6
71A	7/6

EL32	10/6
KTW62/6U7	6/6
VR65A	2/6
CV6	3/6
36	7/6
7193	3/6
954	2/6
955	10/
12A6	10/
EF50	2/6
110TH	£2/9/
811	£1
866/866A	15/
12SH7	5/
12SL7	10/
6K7G	4/6
100TH	20/

Please add Postage on All Valves.
SPECIAL PRICES FOR QUANTITIES



R RECEIVERS

eceivers type ZC955 contain 16
0 Mc. I.F. strip suitable for your
Units are in new condition.

£2/17/6

Packing 15/- extra.

52 GENEMOTORS

28 volt input regulated and filtered; output filtered 300 volts at .26 amps; 150 volts at .01 amps; 14.5 volts at 5.0 amps.

Completely shielded in metal case. 12 x 8 x 5 inches.

R Each **25/**

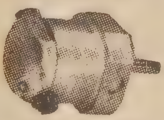
INDICATOR UNITS

These indicator units contain V.R.C. ACR/10 C.R.O. tube and socket. Ideal case for the small scope.
(Used, fair condition.)

30/-
F.O.R.

24 Volt Midget Motors Shunt Wound

Fully Laminated Fields Wound Armature. Sixteen Segment Commutator, ball bearing. Ideal for Model Trains, Hobbyists, etc. Condition new.



Price, each

25/-

Packing and postage: N.S.W., 1/6: Interstate, 2/6.

COMMAND EQUIPMENT

RECEIVERS

3-6 Mcs or 6-9 Mcs.
WITH VALVES

55/-

TRANSMITTERS

WITH VALVES AND CRYSTAL

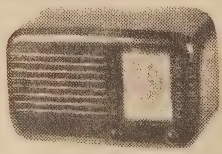
55/-

MODULATORS WITH VALVES

25/-

Post extra on Command Equipment.

MAKE UP THE "LITTLE GENERAL"



£12/17/6

Complete kit of parts for the 1957 "Little General" as featured in R. and H., including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F speaker and kit is complete to the last nut and bolt. (Set wired and tested £2/15/ extra.)
Cabinet size 11½in long, 7in high, 6in deep.
Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly 57/6
Post and Packing: N.S.W., 14/6;
Interstate, 25/.

RADIO ALTIMETER A.P.X.

These units contain valves, midget genemotor (24v) and Wobulator unit used in the R. and H. sweep and marker generator. Also many other useful parts.

£4/17/-
F.O.R.

L—FREE VALVE OFFER

WITH ALL ORDERS OF £6 OR OVER SIX NEW VALVES SELECTED FROM THE FOLLOWING LIST WILL BE SUPPLIED FREE. (COUNTRY ORDERS. PLEASE ADD 2/6 EXTRA POSTAGE.)

- 1C7G — 6H6GT — 6K7G — VR65A — EF50 — 954 — 6C8G — 1P5GT — 1K5G — 7193 — CV6 — 6J7G — 12SK7.

. 22 TRANSCEIVERS

raceiver covers a frequency of 2 to 8 Mcs, and has been
the P.M.G. for use on fishing boats, small craft, bush
ad etc., if converted to crystal control, for which it is
ard. These sets are supplied complete wtih valves, 12v.
per supply, dynamic headphones and microphone leads.

£12/17/6 F.O.R. PACKAGE 15/- EXTRA.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs. and contain 15 6.3 volt valves, including 1-807, 2-6V6, 6-6K7, 2-6K8, 6B8, etc., also 500 microammeter.
Units supplied complete with valves, leads, junction box, genemotor power supply and dynamic headphones and microphone operate from 12v. supply.

£7/15/-

IETROPOLITAN RADIO SUPPLIES

ARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398
ING STREET, ST. PETERS, N.S.W. PHONE LA6087

FERGUSON

NEW RELEASES—NEW APPLICATIONS

Ferguson Transformers Pty Ltd. have pleasure in announcing the release
new transformers and chokes and in advising the correct new and stand
types for use in equipment recently described in Radio, Television & Hobb

NEW R.T. & H. 17" OR 21" TV SET

POWER TRANSFORMER TYPE PF 1193*
(as used in earlier models)
PRIMARY—200, 220, 240V, 50 cps
H.T. SEC—295-0-295V, 275mA
L.T. SEC—6.3V Tapped 5V-3A, 6.3V-9A
*At a new reduced price

FILTER CHOKE TYPE F1-285
1 Henry, 275 mA, 48 ohms D.C.

R.T. & H. 35 WATT P.A. AMPLIFIER

POWER TRANSFORMER—PF 1335
PRIMARY—230, 240V, 50 cps
H.T. SEC.—305-0-305V, 180mA
L.T. SEC.—6.3V-4A C.T. 6.3V-4A 5V-3A

OUTPUT TRANSFORMER—OPM 12
NOMINAL POWER RATING—55 Watts
FREQ. RESPONSE—50-12,000 cps ± 2 db
PRIMARY IMP. PLATE-PLATE—3500 ohms
SEC. IMP.—500, 250, 125, 83, 62, 50 ohms
Also available as Type OPM 13
with Sec. Imp. 15, 12.5, 8, 3.7, 3.1, 2 ohms

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F6-100	6H	100mA	210 ohms D.C.
F12-100	12H	100mA	265 ohms D.C.
F1-285	1H	285mA	48 ohms D.C.
F1-325	1H	325mA	27 ohms D.C

For details of the full FERGUSON range of Filter Chokes refer to our page in the May and June issues

R.T. & H. TRANSISTOR TELEPHONE

DRIVER TRANSFORMER TYPE M
IMPEDANCE RATIO—1 TO 1
PRIM. D.C. RESISTANCE—275 ohms
SEC. D.C. RESISTANCE—325 ohms.

OUTPUT TRANSFORMER TYPE O
POWER RATING—500mW
PRIMARY IMPEDANCE—300 ohms
SECONDARY IMPEDANCE—3.5 ohms

R.T. & H. 17 WATT P.A. AMPLIF

POWER TRANSFORMER—PF 1
PRIMARY—230, 240V, 50 cps.
H.T. SEC.—285-0-285V, 100mA
L.T. SEC.—6.3V-2A C.T., 6.3V-2A, 5V-2

OUTPUT TRANSFORMER—OPM
NOMINAL POWER RATING—15 Watt
FREQ. RESPONSE—50-12,000 cps ± 2
PRIM. IMP.—P.P.-10,000, 8,000, 7 000
SEC. IMP.—15, 12.5, 8, 3.7, 3.1, 2 ohms
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appliances, FERGUSON have recently r
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stereo, and no doubt you will
read the articles on this subject
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radiogram and it is not unlikely
attery motor and turntable com-
vailable before too long.

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few observations about things in

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ood, Qld.) says he would like
for a high-performance receiver
and built around transistors for
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would seemingly be so unique
be little chance of us treating
of receiver many readers want.
watch forthcoming transistor set
hing along the general lines you
as far as the tuning section is
a B-class output stage, you
economy with headphones or
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ent drain is largely proportional
Alternatively, you could prob-
e output stage and drive your
time being, from the secondary
sformer.

) says he has built one of our
ets and thinks that it would be
n for Boy Scouts.
ite agree that Scouts would get
from a small regenerative tran-
ght work with very little aerial
ut, elsewhere, it would need a
and earth to be worthwhile—
the "wire over a tree" variety.
r practical interest in the Scout

Vic.) wishes to know if a 2-
possession is capable of driving

to operate a speaker with a
dependent on the speaker size
of the set in question. The
small set will drive a small
e ease is incorrect. In actual
is true. Less power will be
uce an equivalent amount of
ger speaker than from a small
to the higher efficiency of the
account of its larger magnet

.F., unless we have the circuit
set we are unable to suggest
able for operation with a loud-

ra, A.C.T.) says that he noticed
tails of the CV66 and forwards

VHF triode, similar in appear-
) and requiring the same 9-pin
pean socket. Other designations
54, under which type it appears
lve data book.
6.3.
t: 0.43.
50.
10 mA.
-1.5.
nce: 9,000 umhos.
98.
11 meg.
ns: 1 htr.; 2 grid; 3 grid; 4 plate;
grid; 7 grid; 8 cathode; 9 htr.

s for the above, which will help
g to use this tube.

N.S.W.) has acquired a number
nong which are several 35s, a
D.P. wishes to know if circuits
are available.
its using vintage-valve types are
our query service. The valves
the exception of the 42, require
supply and a transformer with
ill be necessary. The 2A5 and
entical characteristics, with the
heater ratings: the 42 requires

A.D.F. (Pennant Hills, N.S.W.) wants to know whether the EF50 is suitable for use in a TV tuner.

A. This is something we have not tried, A.D.F., partly because these valves and their sockets are uncomfortably large anyway to incorporate in a conventional tuner, and partly because we have our doubts about their ability to work as high as 240 Mc, the frequency of the local oscillator for Channel 9. The pin connections are given in Philips' Valve Data books.

M.D. (Avalon, N.S.W.) is apparently one of our younger readers with a number of interesting comments to make about the magazine and some problems he would like solved. One of these concerns components from an old receiver, particularly a speaker and power transformer, and the connections for each.

A. Many thanks for your letter, M.D., and your change of address has been noted by the appropriate department. We quite appreciate your point concerning the price of the magazine, and that your friends may sometimes have to choose between it and something else. Unfortunately, that happens to most of us at times, on one scale or another, and you may be sure we would not have increased the price had there been any other course available to us. In any case, the present price is still only about 7d a week, and we feel that most schoolboy allowances should run to this without having to sacrifice too many other activities. Your current subscription will not be affected.

You seem to be in some confusion over the loudspeaker. If it is an electro-dynamic type the field coil will be part of the speaker and is probably the 2000 ohm winding you mention. About the easiest way to determine the transformer windings is to first identify the filament windings. These will be wound with heavy-gauge wire. If you can identify the 6.3 volt winding (as distinct from the 5V winding) and feed 6.3 volts into it from another transformer, it will be possible to measure the voltages delivered by the other windings, including the primary. Alternatively, the primary is usually a single winding nearest the core and this can be energised and the other voltages measured. While appreciating that you may not have a meter, we feel that you may be able to borrow one of these, and it is difficult to solve the problem without it.

Your story about the transistor set is very interesting, and we have heard of some other sets of this type giving similar trouble; probably due to the same cause. The old set which takes a long time to warm up may have a weak converter valve, a weak rectifier, or both. It is quite possible for conditions to be such that the converter will oscillate—though only just—after it has had sufficient time to really warm up. We have no converters of the exact type you may have in mind, and we doubt whether any of the valves you list will be of any use. However, a 144 Mc Converter was described in the March, 1953, issue and we can let you have a copy of the circuit if you care to write for it. Many thanks for your comments about the various sections of the magazine, and we will pass your comments on to the Authors. We will also pass your questions on to the Answer Tom section for possible inclusion in the magazine.

B.T. (Moorabbin, Vic.) asks a couple of questions which are too general for a worthwhile answer to be included in these columns.

A. We may be able to find space to deal with your queries in the "Here's Your Answer Tom" feature.

A.B. (Gerringong, N.S.W.) has a commercial set which varies in volume when an appliance or a light is switched on.

A. Possibly there is something intermittent in the set which is triggered by pulses on the power mains but it is more likely that there is some coupling between the first stage of the set and the power mains so that the power mains behave as an aerial. The efficiency of the "aerial" will then vary as appliances are connected across the line. The easiest way to overcome the trouble may be to erect an efficient outdoor aerial and use this in conjunction with a good earth connected to the chassis of the receiver.

D.K. (Wollongong, N.S.W.) asks for details of the gauge of rod used in the 7 Mc amateur mobile aerial described in the July, 1958, issue. He would also like our opinion on the 108 transceiver.

A. The gauge of rod will make very little difference to the length required in the case of the mobile aerial. The main point is that it should be strong enough to withstand the mechanical abuse it is likely to meet when installed on a car. The original aerial was made of spring steel tubing from disposals sources and originally used for tank whip aerials. The 108 was intended to work over short distances and would be of limited use for the general run of amateur radio work, because of its very low effective radiated power. We have in mind the description of a complete mobile equipment for 7 Mc operation in the future but cannot offer any information at the present moment.

C.J.B. (Taranaki, N.Z.) encloses an amplifier circuit for the "Reader Built It" page.

A. Our thanks for the circuit and comments which will be considered for publication in the usual way.

K.B.C. (Avalon, N.S.W.) wonders if there are any radio clubs in his area.

A. Perhaps other readers in this area could help. If not, this may be a good opportunity to form one. (K. B. Carmichael, 21 Alexander Rd., North Avalon.)

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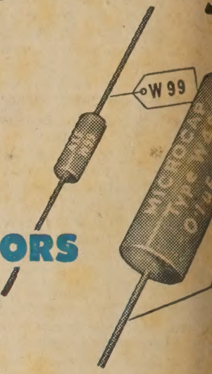

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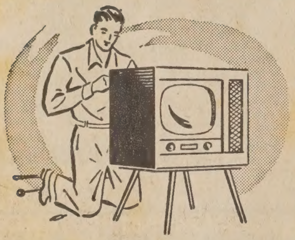

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ABOUT
STOR SETS

ued from page 63)

input capacitance of the
ferred to the top of the
is lower than in the case
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ON

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many important points of
we have been able to dis-
fly and others which we
been able to mention.

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and is made even more
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should serve as an intro-
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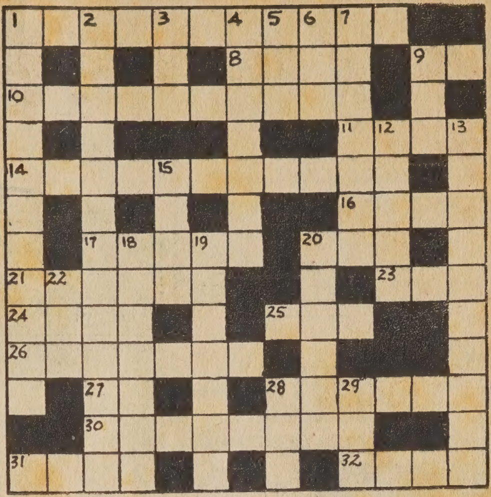
THE R., T.V. & H. CROSSWORD No. 53



ACROSS

1. Caused by excessive drive.
8. Pleasant.
9. Ratio of diameter to circumference (Greek).
10. Elements in a valve.
11. Quality of sound.
14. Part of a crystal detector.
16. Gill.
17. Fat.
20. In time past: Gone.
21. Sine of the complement of an angle.
23. A short sleep.
24. Up to.
25. To prevent.
26. Of Italy.
27. Preposition
28. Type of acid.
30. Type of gas filled control valve.
31. Humorous; earthy.
32. An implement.

DOWN

1. Infinite resistance (two words)
2. Pertaining to electric charges and potentials.
3. Fate that befalls one.
4. Method of colouring the surface of aluminium.
5. Did.
6. Frozen water.
7. Money put aside; savings.
9. A broad shallow vessel.
12. A bright constellation.
13. Oval shape.
15. A small bird.
18. The science of life.
19. The science of colour or markings in animals. Animal camouflage.
20. Slowly (Mus.).
22. They have (French).
28. To weep.
29. Explosive (abbr.).

Solution and further crossword next month

LET'S BUY AN ARGUMENT

(Continued from Page 99)

cases when fed into particular speaker networks or long output leads.

In saying this, I'm not thinking only of home-built amplifiers. We've had some of the big-name commercials units on the bench and seen them produce brusts of oscillation when fed with quite typical high amplitude input signals and into quite typical loads.

The stability margin of an amplifier is dependant on the design of the output transformer and the amount of feedback but it can also be manipulated by the component values within the circuit.

CIRCUIT CONSTANTS

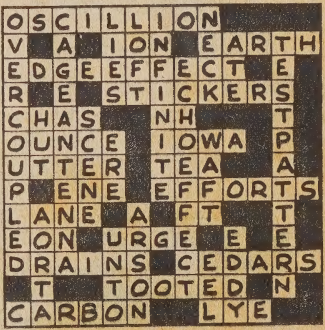
Given a suitably designed transformer, it is indeed possible to use a large order of negative feedback and manipulate the circuit constants to obtain stability under all conceivable load conditions, just as D. F. suggests.

However, the square wave response of the amplifier may then be simply horrible, when viewed on suitable instruments. Which leads to the question: Is it wise to deteriorate square wave response in order to achieve the utmost stability?

And we suddenly find ourselves against the old question of whether the ear can make use of information which is beyond its apparent pass band. Not till we know the answer to that can we decide what is optimum balance between overall response and stability, because the two are often inter-dependant.

It may be a good idea for D. F., in the meantime, to do some square wave checks on the amplifier of his choice.

Last month's solution



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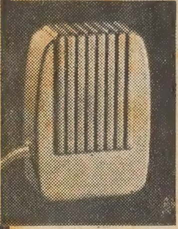

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